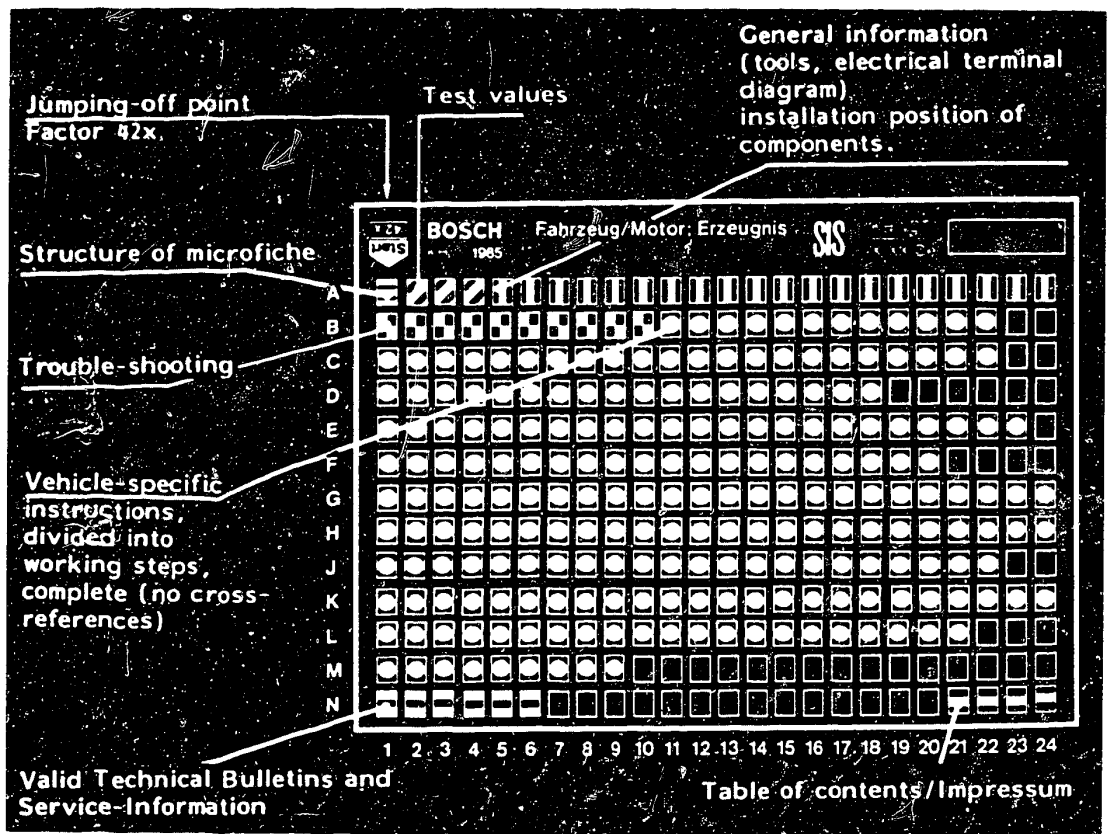


## Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

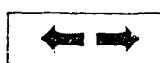
<b>E16</b>	Product component test step
	Vehicle engine

Coordinate

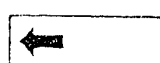
3. Limits of section



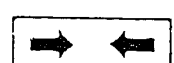
Beginning



Mid-section



End



One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

**C6**

<b>A1</b>	Trouble-shooting program	
-----------	--------------------------	--

## 1. SPECIAL FEATURES

- Closed-loop start-of-injection control
- Exhaust-gas recirculation
- Exhaust turbo-supercharger

## 2. TEST SPECIFICATIONS

### 2.1 Idle speed

Engine warm:	750...800 min <sup>-1</sup>
Engine cold:	900...1050 min <sup>-1</sup>

**C24**

### 2.2 Nozzle-opening pressure

Opening pressure (new nozzles):	150 + 8 bar
Opening pressure (used nozzles):	min. 135 bar
Pressure difference	max. 15 bar

**D7**

### 2.3 Filter test

max. allowable differential pressure:	0.3 bar
---------------------------------------	---------

**D14**

### 2.4 Compression loss:

max. 25 %

**G1**

### 2.5 Injection timing

Engine position = TDC on cylinder 1  
(cyl. 6 on overlap)

**L4**

#### Setting value

Pump position:	0.65 mm ABDC
----------------	--------------

#### Checking value

Pump position:	0.61...0.69 mm ABDC
----------------	---------------------

**A2**

Test specifications  
BMW 524 td





2.6 Compression pressure: approx. 24 bar

minimum

20 bar

**G1**

Requirements for testing:

- Coolant temperature max. +35°C
- Sheathed-element glow plugs unscrewed

2.7 Charge-air pressure

Specification: 0.75...0.85 bar

**L13**

2.8 Charge-air pressure blow-off valve

Opening pressure: 0.95...1.05 bar

**L17**

2.9 Pressure transformer (exhaust-gas  
recirculation)

**M6**

Inlet pressure min: 550 mbar  
Setting pressure: 357...363 mbar  
Checking pressure: 350...370 mbar

**A3**

Test specifications  
BMW 524 td



## 2.10 Tightening torques

Nm

Fastening screws for the fuel-injection pump:	20...24
Fuel-injection pump gear:	45...50
Camshaft gear:	65...70
Tensioning wheel bracket on the engine (bolt and nut):	20...24
Fastening screws for nozzle holder assembly:	40...45
Fuel lines:	20...25
Sheathed-element glow plugs:	20...30
Toothed belt pulley for intermediate shaft:	55...65
Belt pulley/vibration damper:	22...24
Tensioning torque for tensioning pulley holder (new toothed belt):	45...50
Toothed belt, having been used for over 16 000 km (10 000 miles)	30...35
Thermostat housing bleeder screw:	6...10
Cylinder head cover	8...10
Toothed belt, having been used for over 16 000 km (10 000 miles)	30...35
Thermostat housing bleeder screw:	6...10
Cylinder head cover	8...10



### 3. RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

with system test lead 1 684 463 163 and suitable  
multimeter

The following rapid diagnosis chart makes it possible for the experienced diesel expert to quickly check the electrical/electronic periphery and control unit functions for the closed-loop start-of-injection control. To facilitate the detection of faults, the control unit is equipped with a self-diagnosis feature.

1. In the event of malfunctions in the closed-loop start-of-injection control, the "injection" indicator lamp lights up continuously.
2. Through activation of the self-diagnosis feature in the control unit, a pulse is output, depending on the cause of the fault, and is indicated by the injection indicator lamp.

If detailed information is required on how to find the fault and on test procedure, always proceed according to the trouble-shooting chart (Coordinates E1-F6).

The rapid diagnosis chart contains the following  
information:

- Sequence of test steps
- Settings of V and  $\Omega$  program switches
- Notes on how to operate the universal test adapter or other components
- Test specifications for motortester and multimeter
- References to coordinates of the respective, detailed testing and trouble-shooting program.








Test instruction:

Never disconnect or connect the control-unit plug with the ignition on.



# Rapid diagnosis chart for universal test adapter

Triggering of flashing diagnosis and testing for closed-loop start-of-injection control with adapter lead 1 684 463 163

Test step	Switch setting		Button	Flash- ing diagn.	Measurement/Test	Test conditions	Test specifications/ Remarks	For trouble- shooting see Coordinates
	V	$\Omega$						
1	8	-	-	0	Voltage at control unit	Disconnect control-unit plug. Switch on ignition.	8 ... 15 V	E 8
2		19	3	4	Test of self-diagnosis of control unit	Connect control-unit plug. Switch on ignition.	Simulation of failure of engine-speed sensor	E 10
3		19	3	-	Triggering of diagnosis readout	Connect control-unit plug. Start engine. Press button 3 for 1...2 sec.	Flashing diagnosis depending on faults of test steps 4-7	E 12
4		1	-	2	Resistance of needle-movement sensor	Disconnect control-unit plug.	90...135 $\Omega$ at $< 80^{\circ}\text{C}$	E 14
4.1	1	-	-	2	Voltage of needle-movement sensor	Connect control-unit plug. Switch on ignition.	3.0 ... 6.0 V	
5		6	-	4	Resistance of engine-speed sensor	Disconnect control-unit plug.	860 ... 1060 $\Omega$	E 16
6		9	-	6	Resistance of timing valve	Disconnect control-unit plug.	15 ... 22 $\Omega$	
6.1	-	-	2	-	Signal of timing valve; engine warm	Connect control-unit plug. Disconnect needle-movement sensor. Start engine. Coolant temp. $20^{\circ}\text{C}$ Connect pocket tester to test sockets 1 and 2 of test adapter. Measuring range (dwell angle).	On/off ratio 28 ... 32%	E 18
6.2	-	-	1	-	Signal of timing valve; engine cold		On/off ratio 13 ... 17%	
7		5	-	8	Resistance of temperature sensor (engine temperature)	Disconnect control-unit plug. Engine temperature: $+15...+30^{\circ}\text{C}$ Engine temperature: approx. $+80^{\circ}\text{C}$	1.3 ... 3.6 k $\Omega$ 250 ... 390 $\Omega$	E 22
8	9	-	-	-	Voltage at engine-speed output	Connect control-unit plug. Operate engine at idle speed.	0.6 V - 3.0 V	F 1
9		4	-	-	Switch on/off of EGR valve	Connect control-unit plug. Start engine and raise engine speed. Measure at $\Omega$ sockets.	Switch-on point: 1000 $\text{min}^{-1}$ . Switch-off point: 2800 $\text{min}^{-1}$	F 3

**A6**

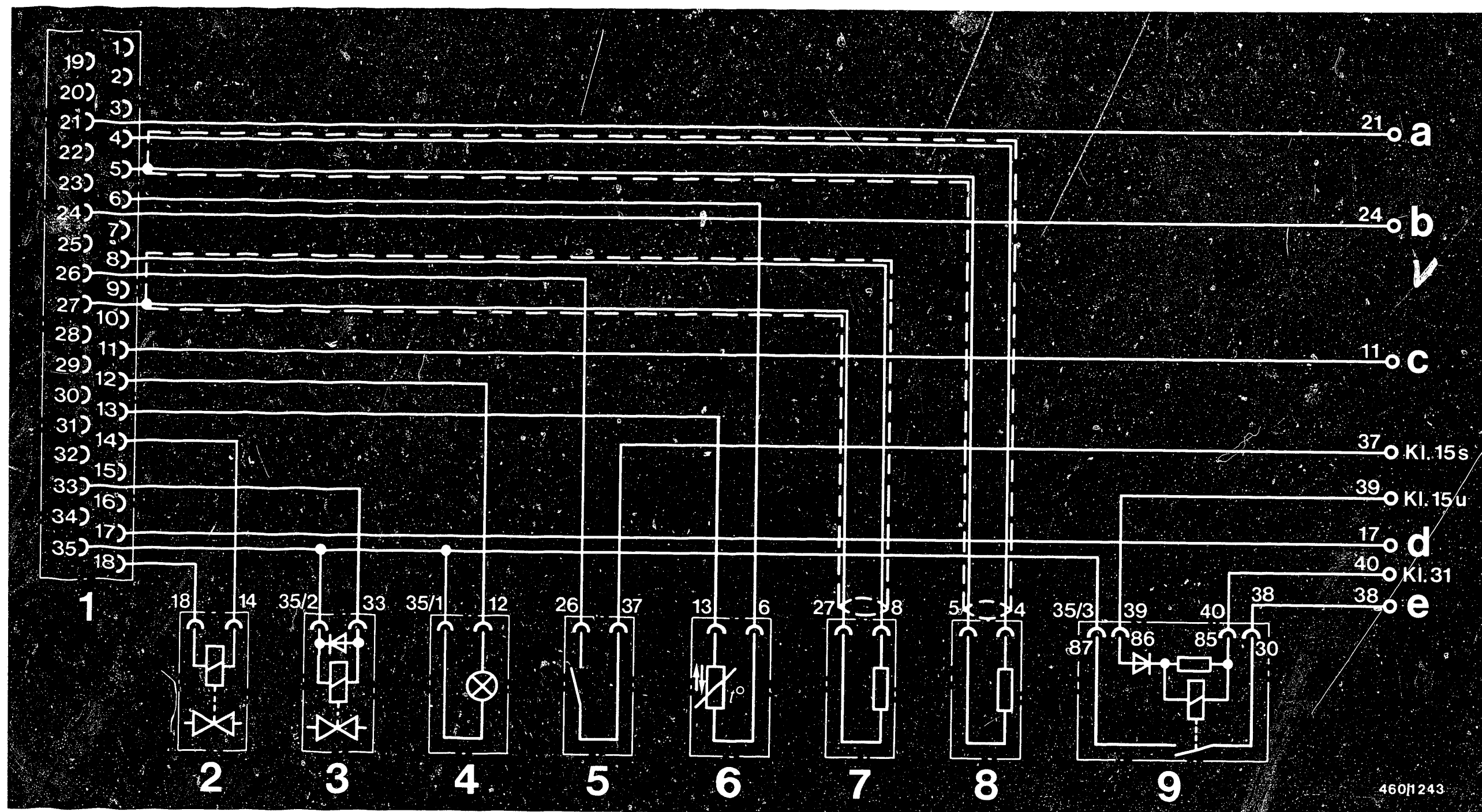
Rapid diagnosis chart  
BMW 524 td



**A7**

Rapid diagnosis chart  
BMW 524 td





1 = Control-unit plug  
 2 = Timing valve  
 3 = Solenoid-operated valve  
 for exhaust-gas recirculation  
 4 = Diagnosis lamp

5 = Load microswitch  
 6 = Temperature sensor (engine)  
 7 = Engine-speed sensor  
 8 = Needle-movement sensor  
 9 = Incorrect-polarity protection relay

a =  $t_D$  signal (engine-speed output)  
 b = Start-of-injection measuring output  
 c = Start-of-injection unconditioned signal  
 d = Battery (-)  
 e = Battery (+)

**A8**

Circuit diag. of st.-of-inj. control  
 BMW 524 td

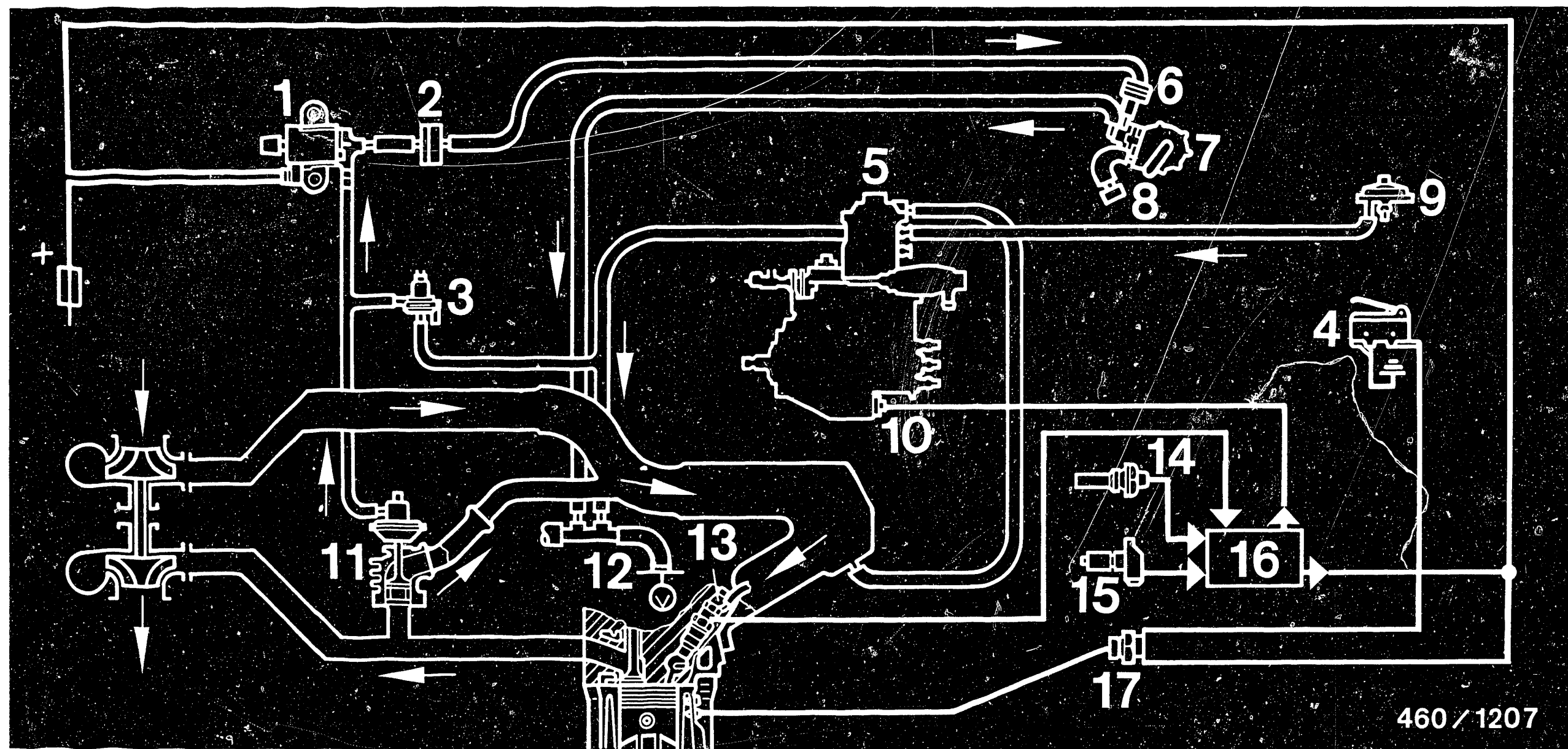


**A9**

Circuit diag. of st.-of-inj. control  
 BMW 524 td



4601243



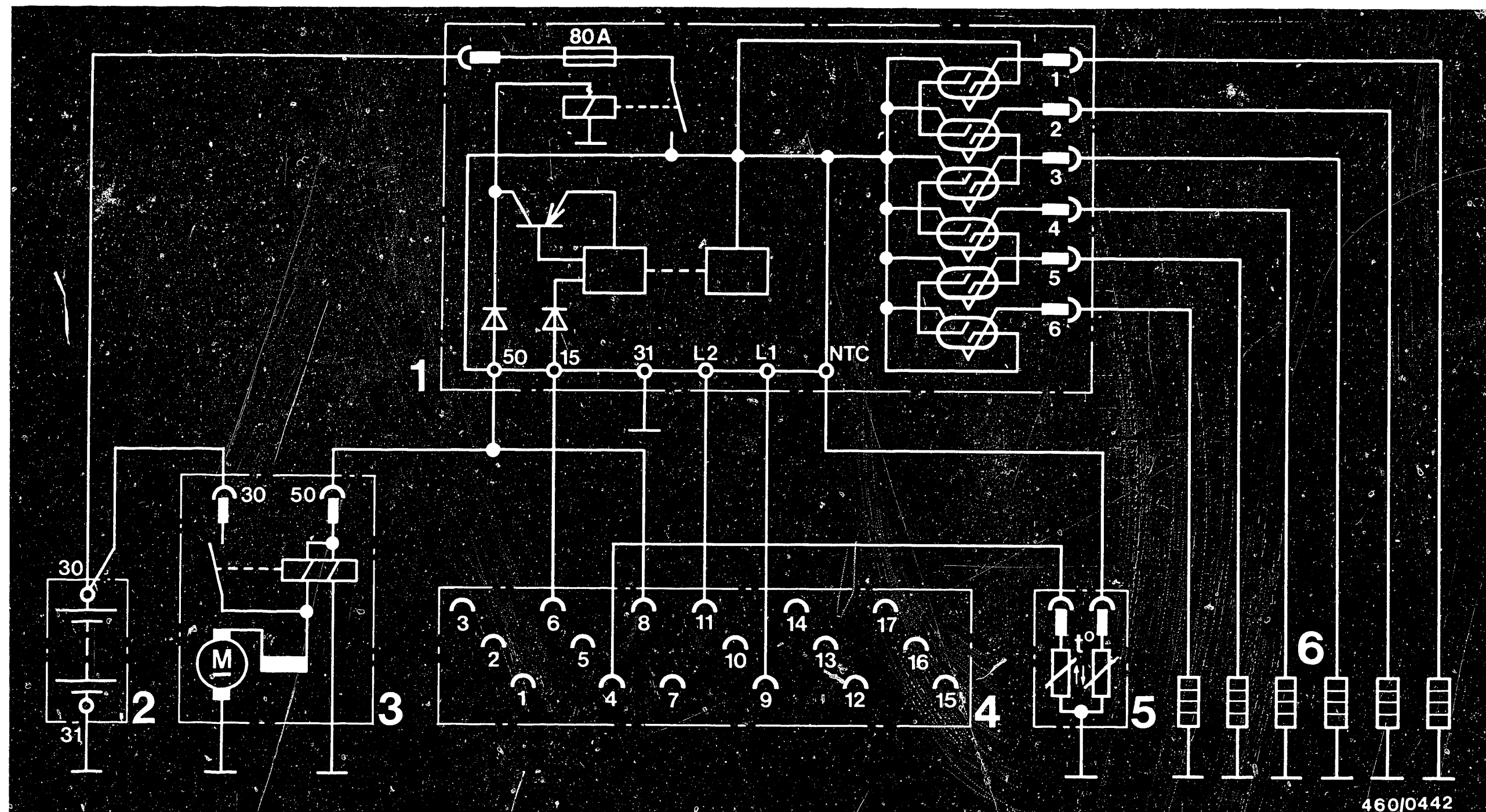
460 / 1207

- 1 = Change-over valve
- 2 = Restriction
- 3 = ALDA air valve
- 4 = Microswitch
- 5 = Altitude- and manifold-pressure compensator (ALDA)

- 6 = Damper
- 7 = Pressure transformer
- 8 = Filter
- 9 = Reference pressure unit
- 10 = Timing valve
- 11 = EGR valve

- 12 = Vacuum pump
- 13 = Needle-movement sensor
- 14 = Temperature sensor
- 15 = Engine-speed sensor
- 16 = Control unit
- 17 = Water-temperature sensor

# 5. SYSTEM CIRCUIT DIAGRAM OF EXHAUST-GAS RECIRCULATION



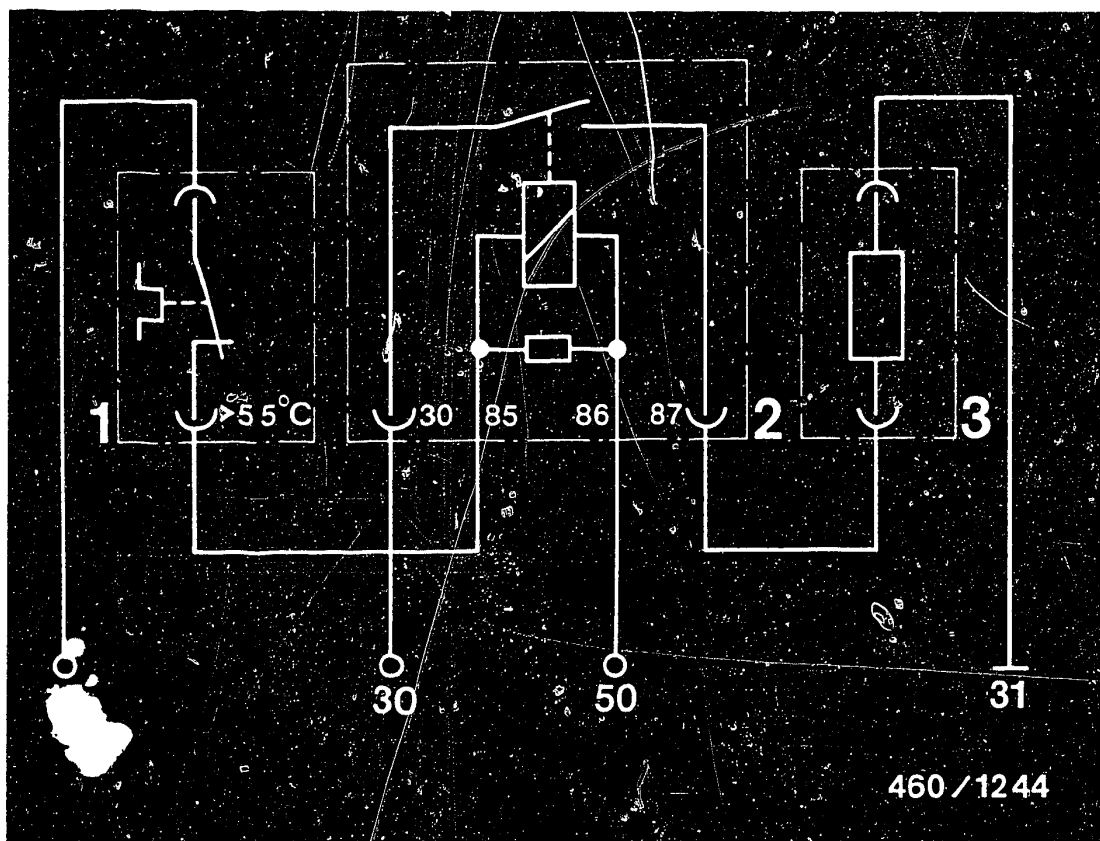
460/0442

1 = Glow-duration unit  
2 = Battery

3 = Starting motor  
4 = Diagnostic plug

5 = Temperature sensor  
6 = Sheathed-element glow plugs

# 6. TERMINAL DIAGRAM OF PREHEATING SYSTEM



- 1 = Thermo-switch 5.5°C
- 2 = Fuel heater relay
- 3 = Heating element

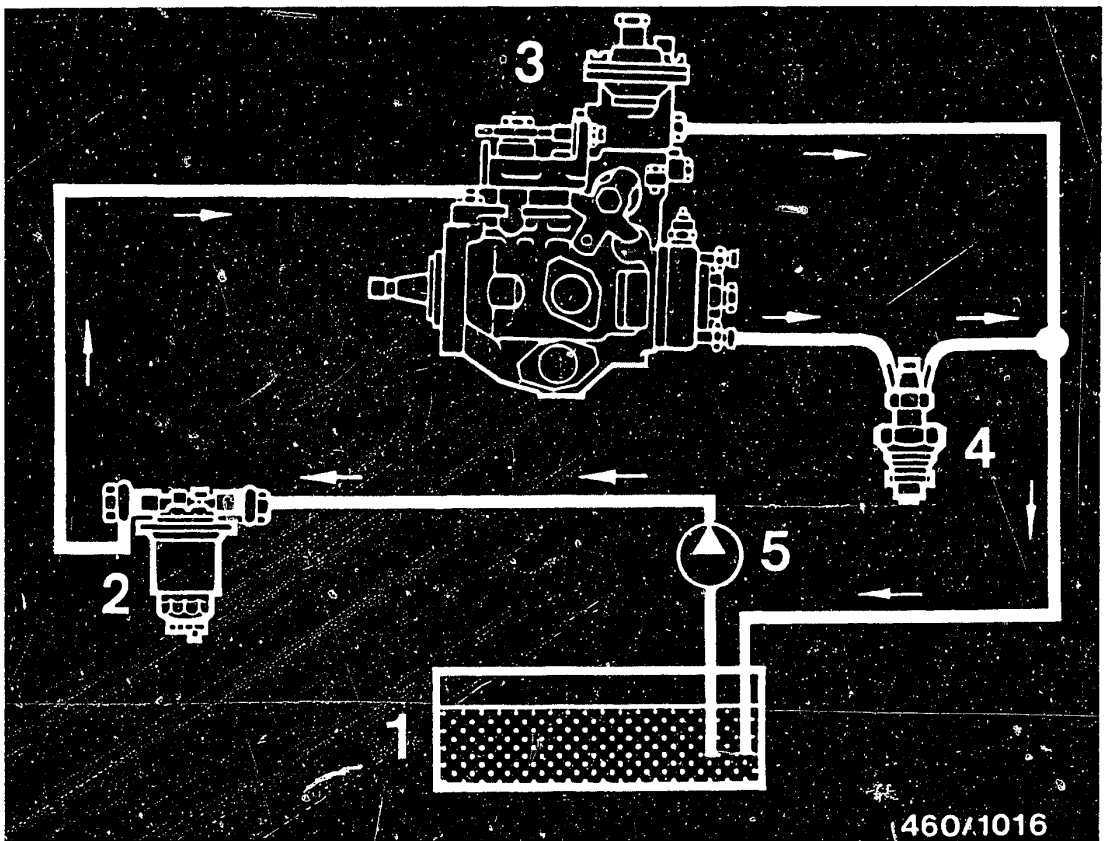
## 7. TERMINAL DIAGRAM OF FUEL PREHEATING

**A14**

Terminal diagram of fuel preheating  
BMW 524 td







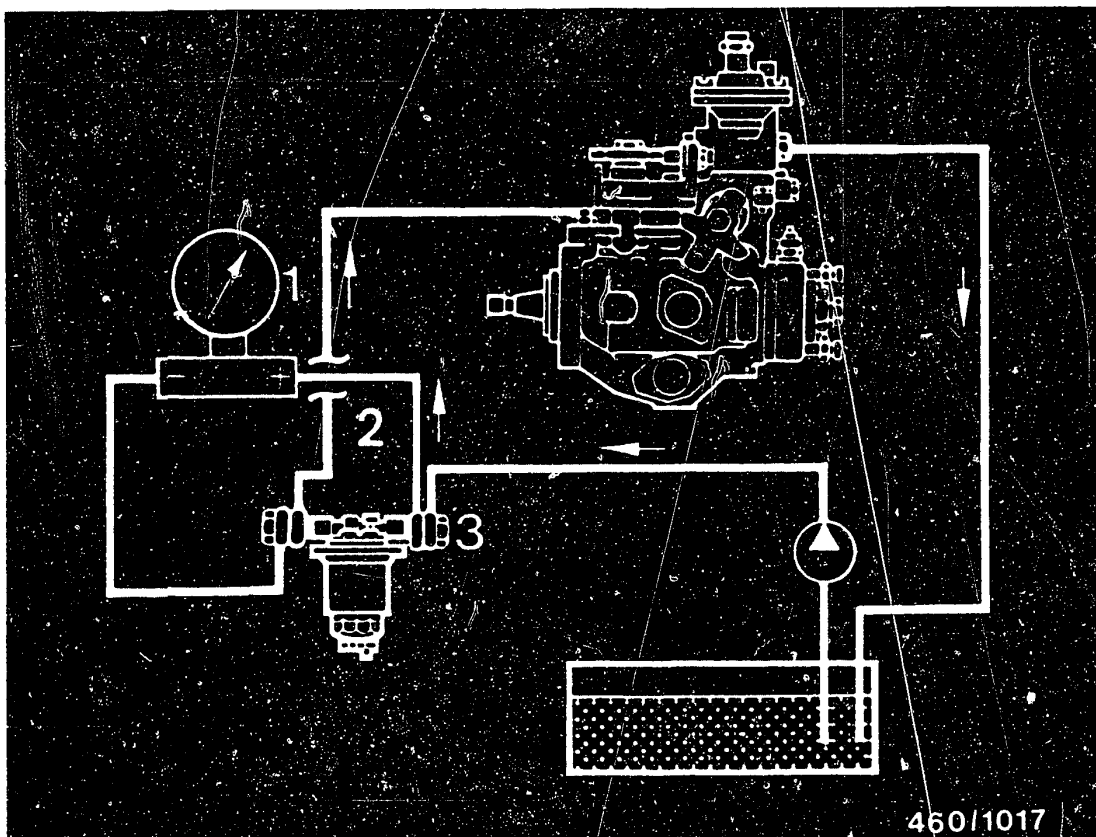
- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type fuel-injection pump
- 4 = Injection nozzles
- 5 = Pre-supply pump

#### 8. Diagram of fuel lines

The fuel lines are connected as shown in the above diagram.

The fuel flows in the direction of the arrows.





- 1 = Differential-pressure gauge
- 2 = Filter outlet (use inlet union and extra-long inlet-union screw 2 443 456 020)
- 3 = Filter inlet (use inlet union and extra-long inlet-union screw 2 443 456 020)

#### 8.1 Connection diagram for filter test

Connect differential-pressure gauge to fuel filter using appropriate connecting pieces.



## 9. TEST EQUIPMENT AND TOOLS

Description	Part Number	Use
Puller	KDEP 1137	Removing injection-pump gear
Setting mandrel	KDEP 1138	Locking injection-pump gear
Setting mandrel	KDEP 1139	Locking flywheel
Toothed-belt tester	KDEP 1121	Testing toothed-belt tension
Locking device	KDEP 1136	Locking camshaft
Box wrench	KDEP 1115	Loosening/tightening injection pumps
Measuring tool	KDEP 1085	Injection timing
Adapter for measuring tool	KDEP 1127	Injection timing
Mini dial indicator 1/100 mm graduations	commercially available  e.g. Hahn & Kolb 7000 Stuttgart Part No.33 003	Injection timing
Pressure tester	KDJE-P 100	Testing charge-air pressure



## Test equipment and tools (continued)

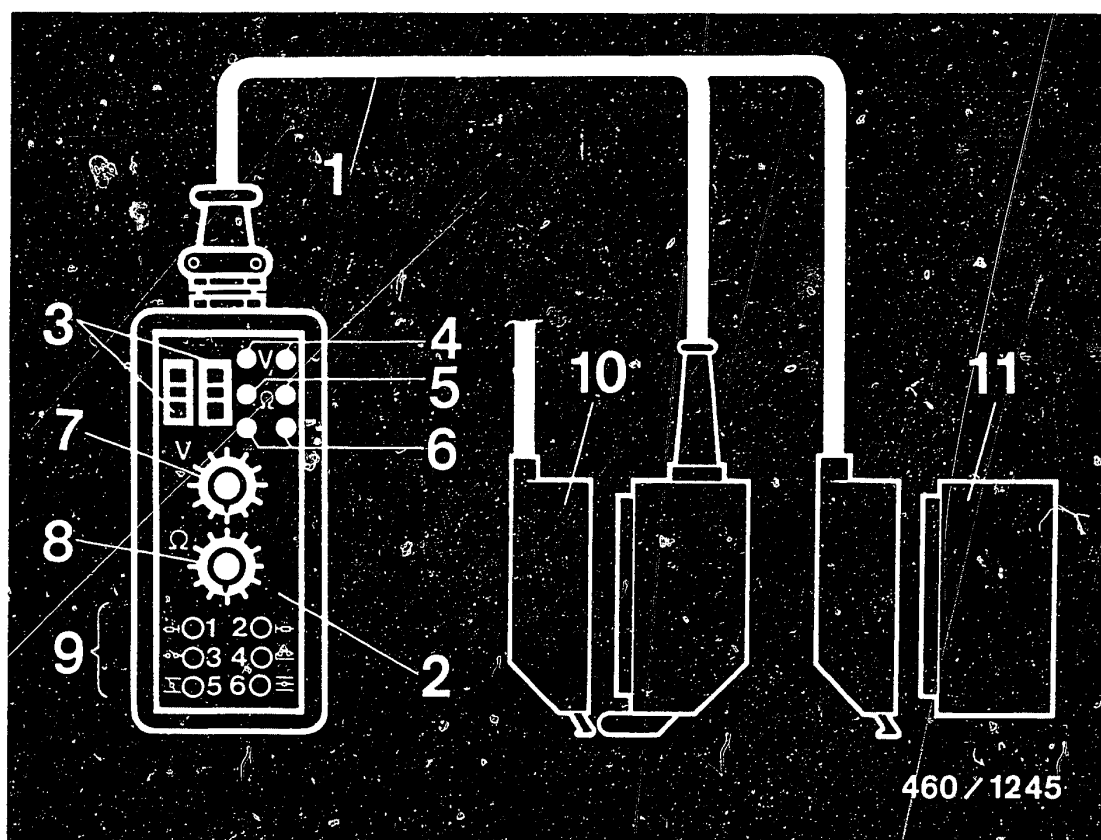
Description	Part Number	Use
Nozzle tester	EFEP 60 H 0 681 200 502	Testing injection nozzles
Compression-loss tester	EFAW 210 A 0 681 001 901	Testing engine compression loss
Tachometer	commercially available e.g. Dr.E.Horn GmbH Meßgerätefabrik Postfach 40 7036 Schönaich Order Desig: HT 446 (with digital display)	Adjusting engine speed
Differential-pressure gauge	commercially available Part No. NG 160/311-911 -1.0+4.0 bar Haenni Nauheimer Str. 78-80 7000 Stuttgart 50	Filter test
Evaluation unit	0 684 102 050	Smoke test
Accessory box w. metering unit	0 681 169 038	
Press-in sleeve	KDEP 1562	Mounting nozzle holders, seal ring
Pressure-piece	KDEP 1043/0/5	Dismantling and assembling nozzle-holder assy



## Test equipment and tools (continued)

Description	Part Number	Use
Universal test adapter	ETT 018.01 - 0 684 101 801	Testing closed-loop start-of-injection control
Test lead	1 684 463 163	Testing closed-loop start-of-injection control
Multimeter	commercially available e.g. Mislco Master 50 K	Testing closed-loop start-of-injection control and EGR
Compression tester	commercially available	Testing engine compression
Connecting nipple Angle-piece	6 220 103 236  6 220 103 163 Moto-Meter Daimlerstr. 6 7250 Leonberg	Testing engine compression Testing engine compression
VA tester	ETT 011.00 0 684 101 100	Testing preheating system
Pocket motortester (digital)	KTE 001.03 0 684 400 103	Testing closed-loop start-of-injection control

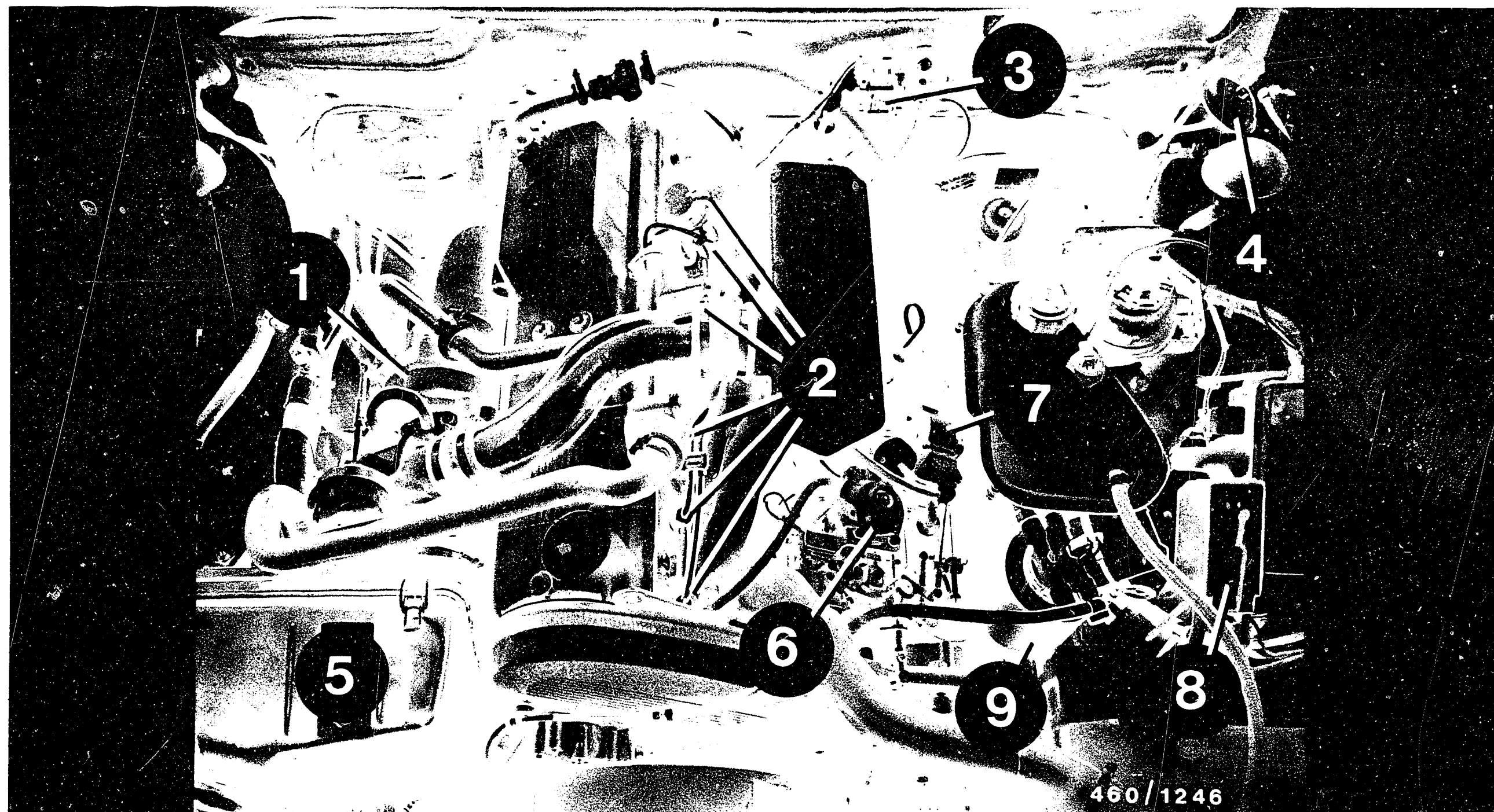




460 / 1245

### Universal test adapter with adapter lead

- 1 = Adapter lead  
(Part No. 1 684 463 163)
- 2 = Universal test adapter  
(Part No. 0 684 101 801)
- 3 = Test wells for motortester
- 4 = Test sockets  
(for voltage measurements)
- 5 = Test sockets  
(for resistance measurements)
- 6 = Test sockets
- 7 = "Volt" program switch
- 8 = "Ohm" program switch
- 9 = Button panel for simulation  
of operating conditions
- 10 = Control-unit plug
- 11 = Control unit



1 = Turbocharger  
2 = Injection nozzles  
3 = EGR change-over valve

4 = Control box  
5 = Air filter  
6 = Injection pump

7 = EGR pressure transformer  
8 = Preheating system  
9 = Fuel filter

#### 10. INSTALLATION POSITION OF COMPONENTS

**A21**

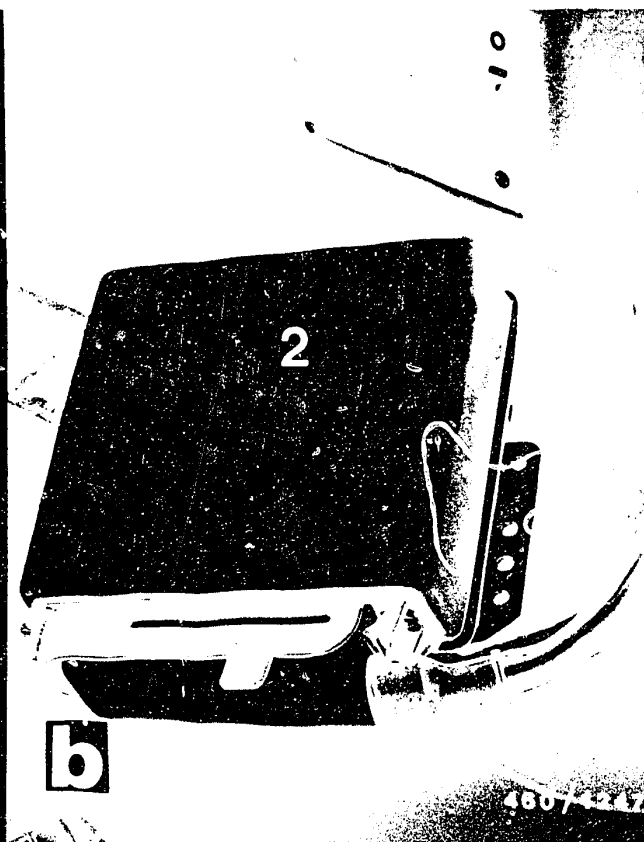
Installation position of components  
BMW 524 td



**A22**

Installation position of components  
BMW 524 td





1 = EGR valve (turbocharger)

2 = Control unit (in glove compartment under a cover)





## 11. IMPORTANT GENERAL INFORMATION

- Never start the engine without the battery securely connected.
- Do not use a starting aid with more than 16 V or a fastcharger for starting.
- Never disconnect the battery from the vehicle electrical system with the engine running.
- Disconnect the battery from the vehicle electrical system before fast-charging.
- Remove the control unit at temperatures above +80°C (paint-drying installation).
- Make sure that all connectors of the wiring harness are correctly seated.
- Never disconnect or connect the control-unit plug with the ignition on.
- Remove the control unit before performing electrical welding work (e.g. spot welding).
- In the case of nozzle holders with inductive start-of-injection sensor (cylinder 4 on this vehicle), the after-sales service is allowed only to correct the opening pressure.
- If the closed-loop start-of-injection control fails, the exhaust-gas recirculation system is inoperative.
- Looking for a fault in the diesel fuel-injection system as a result of a customer complaint? Trigger self-diagnosis of control unit (test 3).

If no flashing code is output, then there is no fault in the closed-loop start-of-injection control.



## 12. TROUBLE-SHOOTING

### Customer complaint (fault symptom)

1. Engine fails to start or starts only with great difficulty when warm							
2. Engine fails to start or starts only with great difficulty when cold							
3. Engine hunts at idle							
4. Rough idle with engine warm							
5. Engine missing during vehicle operation							
6. Unsatisfactory performance							
Cause (component fault)						Coordinates	
●	●			●	●	Tank empty; tank vent clogged	B 9
	●			●	●	Fuel preheating defective	D 17
	●		●			Injection sequence does not correspond to firing sequence (check routing of fuel-injection tubing)	B 10
				●		Overflow restriction clogged	B 11
●	●					Shutoff device defective	B 12
		●		●	●	Inlet-union screws of inlet and return lines clogged (see diagram of fuel lines)	B 16
●	●		●	●	●	Air in fuel system	B 18
	●					Heavy paraffin deposits in filter in winter (replace filter box)	B 20
●	●			●	●	Lines leaking or broken; connections loose	C 1
●	●			●	●	Supply lines clogged (check fuel lines)	C 4
●	●			●	●	Injection lines clogged or constricted (check fuel lines)	C 4
			●		●	Exhaust-gas recirculation system defective	M 1

**B1**

Trouble-shooting  
BMW 524 td


**B2**

Trouble-shooting  
BMW 524 td



# Trouble-shooting (continued)

1. Engine fails to start or starts only with great difficulty when warm							
2. Engine fails to start or starts only with great difficulty when cold							
3. Engine hunts at idle							
4. Rough idle with engine warm							
5. Engine missing during vehicle operation							
6. Unsatisfactory performance							
					<u>Cause</u> (component fault)	<u>Coordinates</u>	
					● Engine air filter clogged	C 5	
			●		Idle speed incorrect	C 12	
●	●		●		● Injection nozzle defective	D 4	
	●		●		● Injection timing incorrect	L 4	
●	●			●	● Fuel filter clogged (differential-pressure test)	D 14	
	●				Preheating system defective	F 7	
					● Timing device defective	F 19	
	●		●		Engine compression poor or uneven	G 1	
					● Maximum engine speed incorrectly adjusted (remove injection pump)	G 11	
●	●	●	●	●	● Injection pump (governor) defective or out of adjustment (remove injection pump)	G 11	
					● Check turbocharger for leaks and charge-air pressure	L 13	
					● Timing valve defective (check closed-loop start-of-injection control)	E 1	

**B3**

Trouble-shooting  
BMW 524 td



**B4**

Trouble-shooting  
BMW 524 td



# Trouble-shooting (continued)

7. Insufficient engine power in conjunction with high fuel consumption, possibly smoking

8. Engine cannot be stopped

9. Engine runs rough, in conjunction with black smoke in full-load range; possibly lack of power

10. Fog-like smoke in full-load range (white)

11. Incorrect engine speeds

12. Engine will not rev up when cold

13. Distributor-type fuel-injection pump overheating

14. Black smoke in full-load range; possibly lack of power  
Cause (component fault)

Coordinates

			●		●			Supply lines clogged (check fuel lines)	C 4
			●		●			Injection lines clogged or constricted (check fuel lines)	C 4
							●	Engine air filter clogged	C 5
				●				Idle speed incorrect	C 12
		●						Injection nozzle defective	D 4
●		●	●		●			Injection timing incorrect	L 4
			●		●			Fuel filter clogged (differential-pressure test)	D 14
		●	●					Timing device defective (remove injection pump)	F 19
●					●			Engine compression poor or uneven	G 1
				●				Maximum engine speed incorrectly adjusted (remove injection pump)	G 11
●	●	●	●	●	●	●		Injection pump (governor) defective or out of adjustment (remove injection pump)	G 11
		●	●					Timing valve defective (check closed-loop start-of-injection control)	E 1

**B5**

Trouble-shooting  
BMW 524 td



**B6**

Trouble-shooting  
BMW 524 td



# Trouble-shooting (continued)

7. Insufficient engine power in conjunction with high fuel consumption, possibly smoking									
8. Engine cannot be stopped									
9. Engine runs rough, in conjunction with black smoke in full-load range; possibly lack of power									
10. Fog-like smoke in full-load range (white)									
11. Incorrect engine speeds									
12. Engine will not rev up when cold									
13. Distributor-type fuel-injection pump overheating									
14. Black smoke in full-load range; possibly lack of power									
<u>Cause</u> (component fault)									
			●		●			Tank empty; tank vent clogged	B 9
					●			Fuel preheating defective	D 17
		●		●	●			Injection sequence does not correspond to firing sequence (check routing of fuel-injection tubing)	B 10
						●		Overflow restriction clogged	B 11
	●							Shutoff device defective	B 12
			●	●	●			Inlet-union screws of inlet and return lines clogged (see diagram of fuel lines)	B 16
			●		●			Air in fuel system	B 18
					●			Heavy paraffin deposits in filter in winter (replace filter box)	B 20
●								Lines leaking or broken; connections loose	C 1
●								Engine timing out of adjustment	K 1
							●	Exhaust-gas recirculation system defective	M 1

**B7**

Trouble-shooting  
BMW 524 td



**B8**

Trouble-shooting  
BMW 524 td





### 13. CHECK TANK VENT

Open filler cap.

If the fault disappears after opening the filler cap, the tank vent is defective.

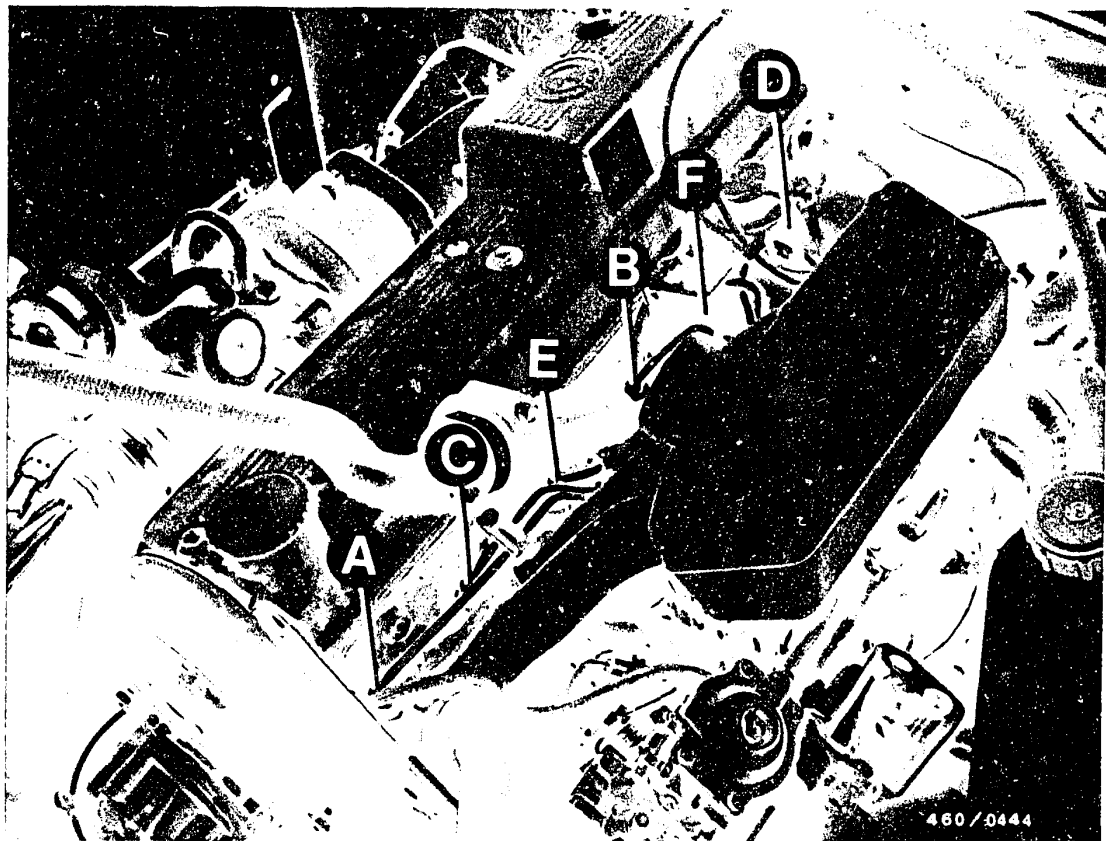
Check the tank vent for clogging.

**B9**

Check tank vent

BMW 524 td





#### 14. Check routing of fuel-injection tubing

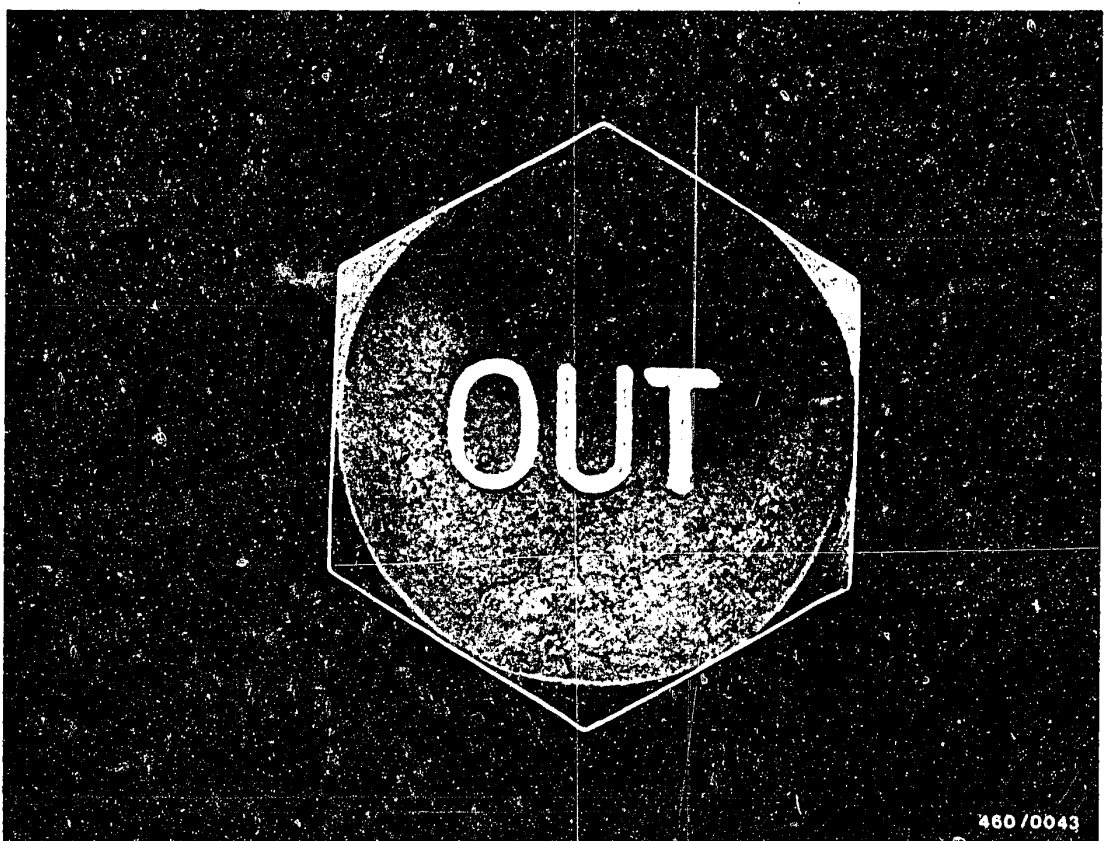
The individual fuel-injection lines are held together by clamps so that it is impossible for the outlets to be mixed up. If, however, there is any doubt, check the routing of the lines as shown in the picture above. The pairing of the fuel-injection pump outlets with the individual engine cylinders is identified by the letters A - F.

**B10**

Check fuel-injection tubin

BMW 524 td





15. Check overflow restriction

Unscrew overflow restriction on fuel-injection pump (marked "out").

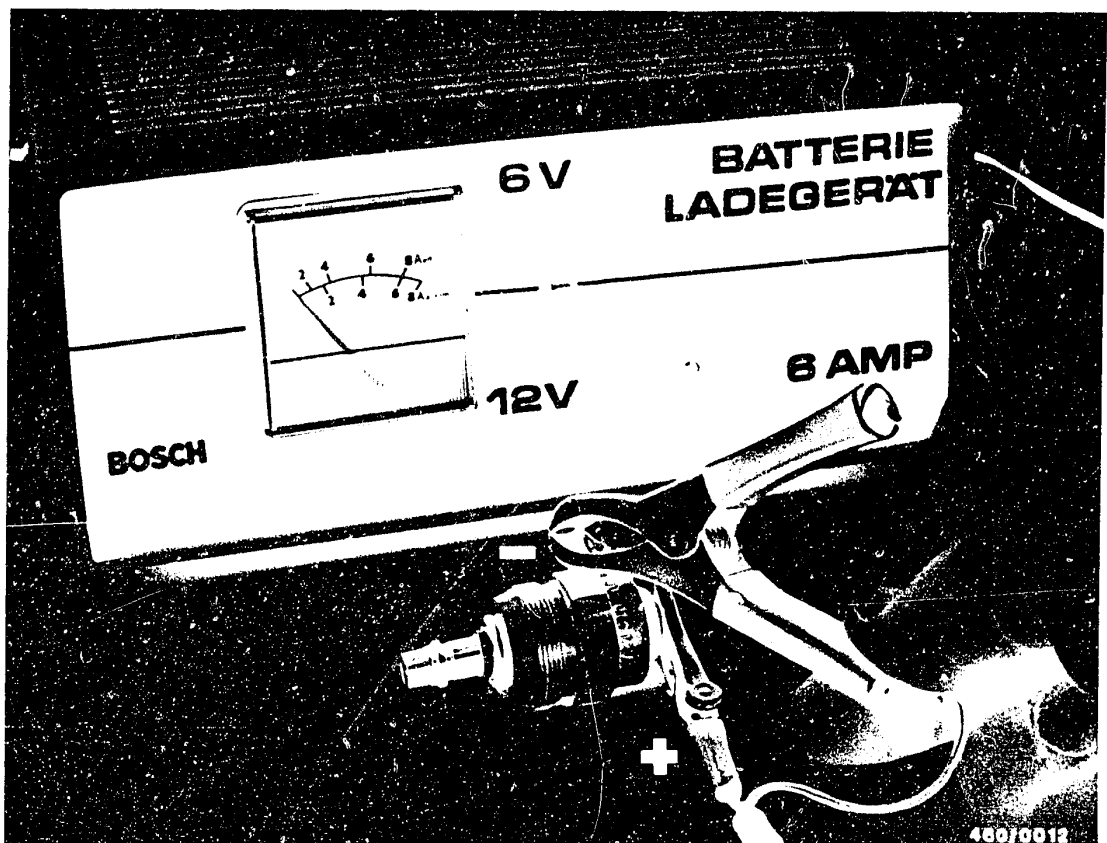
Perform visual inspection of wire screen for impurities. If in doubt, replace overflow restriction.

**B11**

Check overflow restrictic  
BMW 524 td







## 16. CHECK OPERATION OF SHUTOFF DEVICE

### 16.1 Engine fails to start

Check whether solenoid-operated valve is supplied with voltage (min. 10 V) with glow-plug and starter switch switched on (drive position).

If voltage is present, remove fuel-injection tubing and take out solenoid-operated valve.

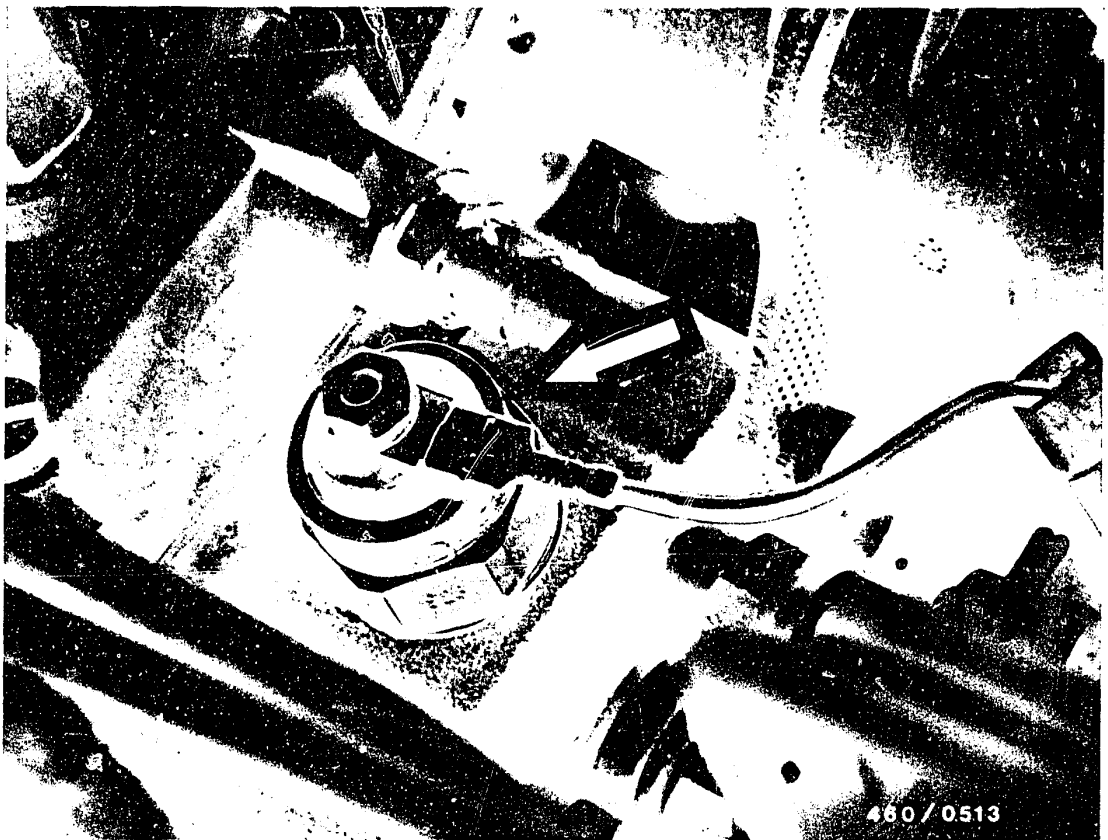
Cleanliness is essential.

When removed, check operation of solenoid-operated valve.

#### Note:

When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.





## 16.2 Engine cannot be switched off

With the glow-plug and starter switch in the stop position there must be no voltage across the solenoid-operated valve, i.e. the fuel inlet to the distributor-pump plunger is interrupted.

If the engine runs on, although there is no voltage across the solenoid-operated valve, the engine can be switched off as follows:

### • Vehicles with manually-shifted transmission

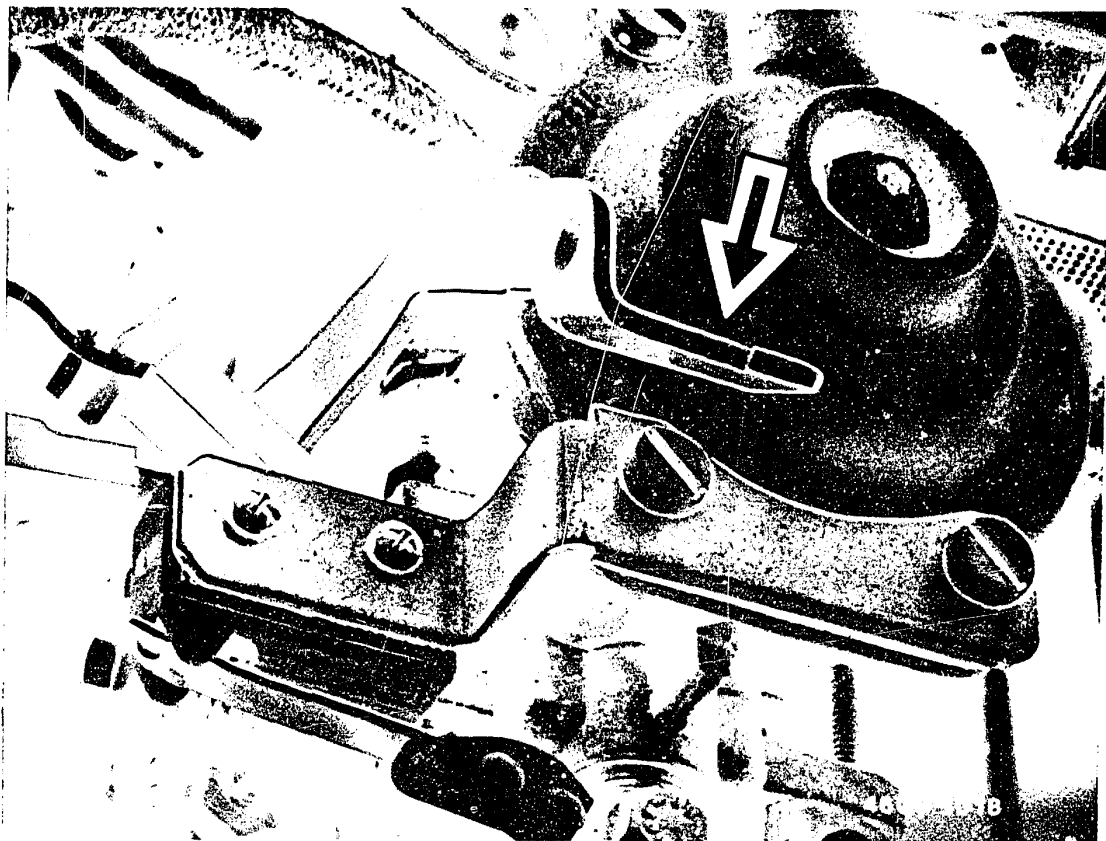
select 3rd or 4th gear. Jam on footbrake and let out the clutch.

**B13**

Check shutoff device

BMW 524 td

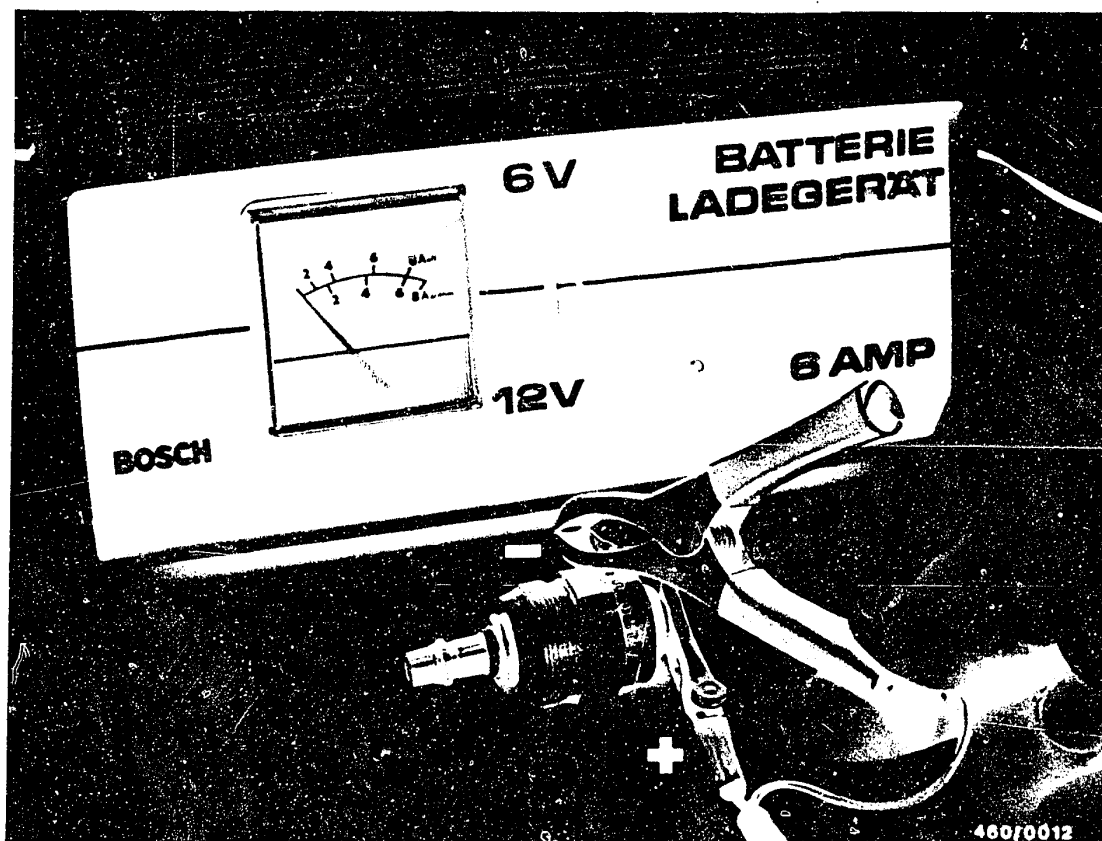




- Vehicle with automatic transmission

Operate the emergency shutoff lever on the fuel-injection pump. (Arrow)





#### 16.2.2 Solenoid-operated valve test

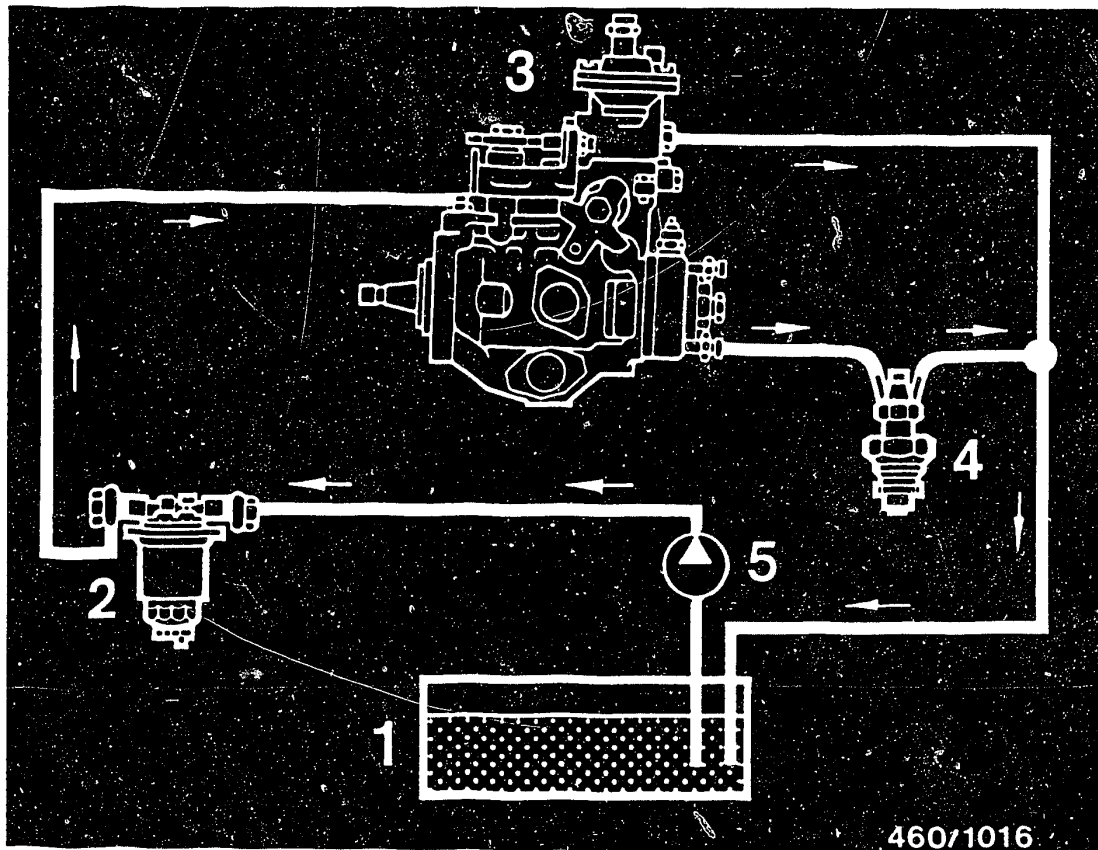
Remove fuel-injection tubing.  
Take out solenoid-operated valve.  
Cleanliness is essential.

When removed, check operation of solenoid-operated valve.

#### Note:

When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.  
Check valve seat in hydraulic head (visual inspection).





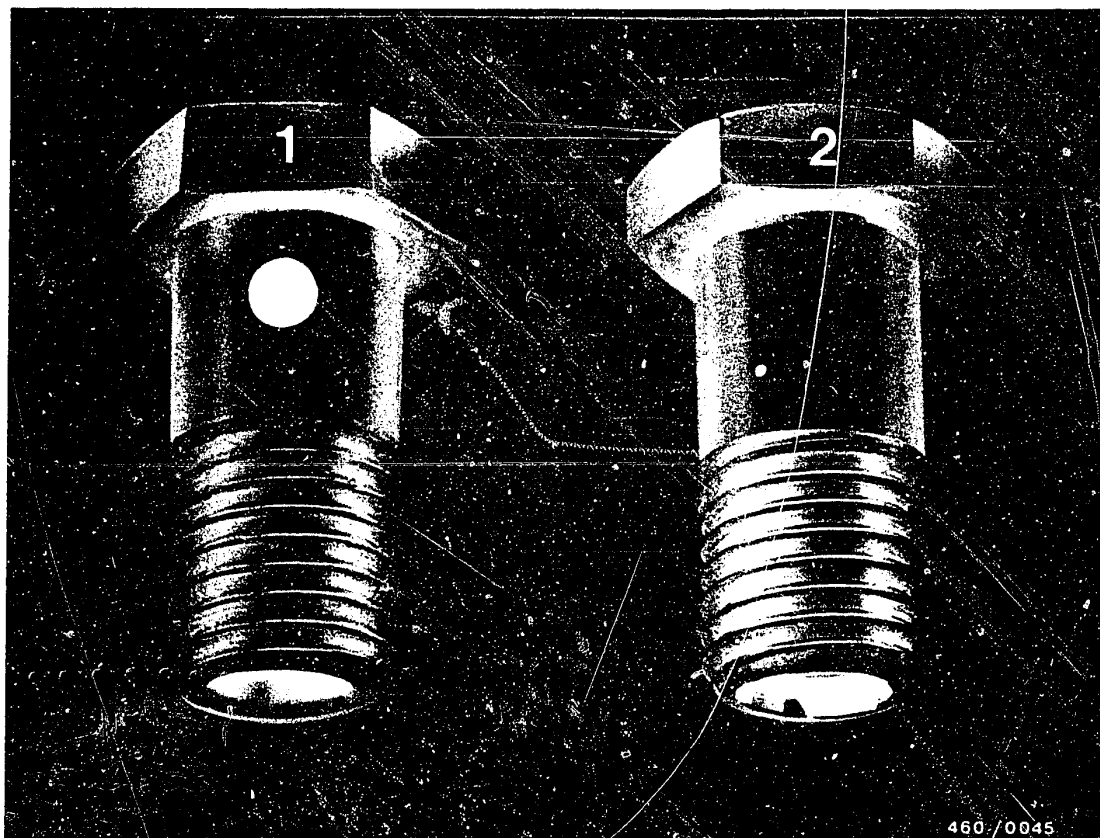
- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type fuel-injection pump
- 4 = Injection nozzles
- 5 = Fuel pre-supply pump

#### 17. DIAGRAM OF FUEL LINES

The fuel lines are connected as shown in the above diagram.

The fuel flows in the direction of the arrows.

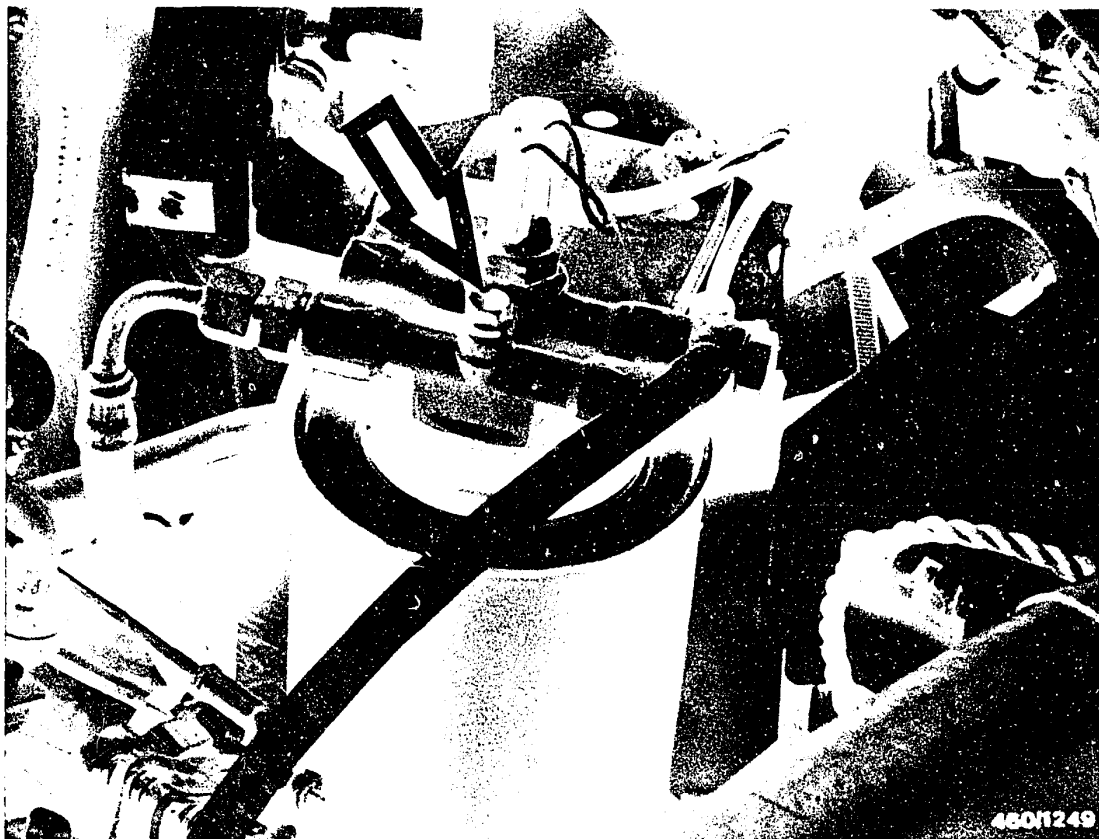




As regards the connections to the fuel-injection pump, ensure that the inlet-union screw for fuel inlet (1) and the throttle screw for fuel return (2) are not mixed up.

The throttle screw is located on the cover of the fuel-injection pump and the head of the screw is marked with the word "out".





### 18. BLEED FUEL SYSTEM

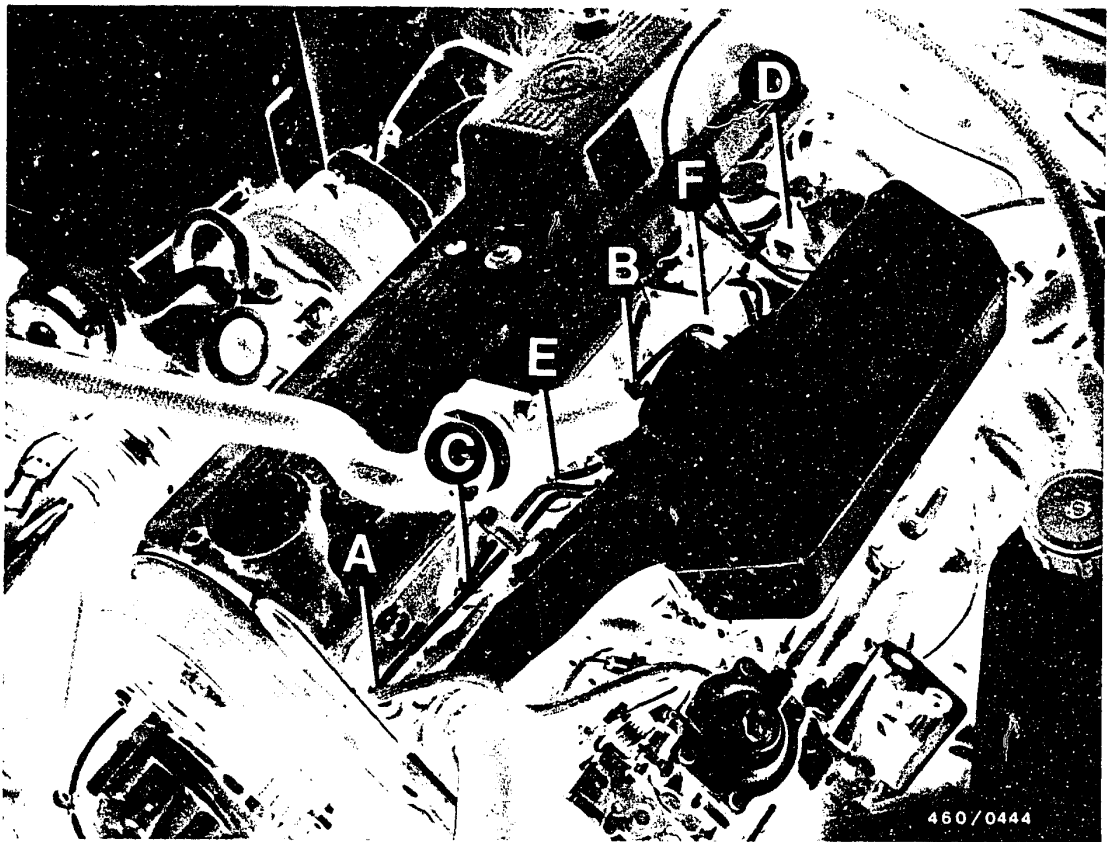
Bring glow-plug and starter switch to "engine operation" position.

Loosen bleeder screw on fuel filter (arrow).

Let fuel supply pump run until fuel escaping from bleeder screw is free of bubbles.

Tighten bleeder screw.





Loosen union nuts of fuel-injection tubing (A...F) on injection-nozzle holders.

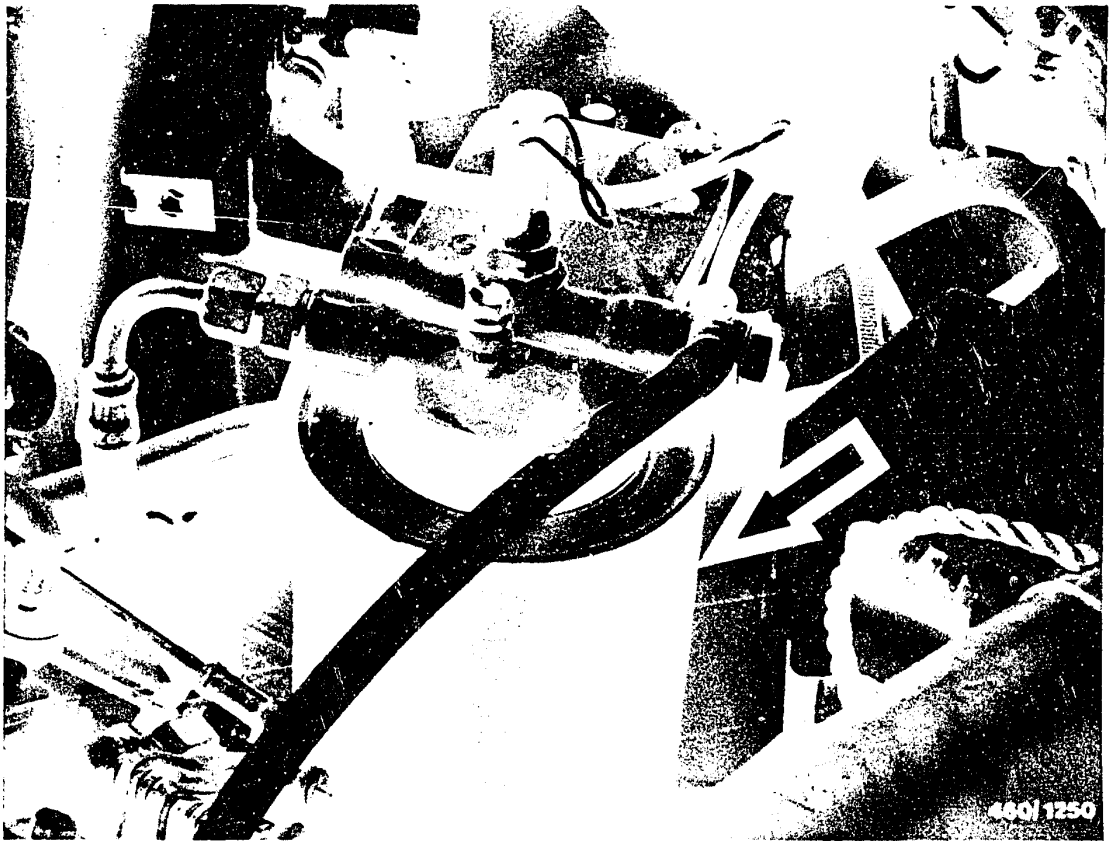
Operate starting motor until fuel escapes from the union nuts of the injection-nozzle holders.

Tighten union nuts.

Operate starting motor until engine starts.







## 19. REPLACE AND DRAIN WATER FROM FUEL FILTER

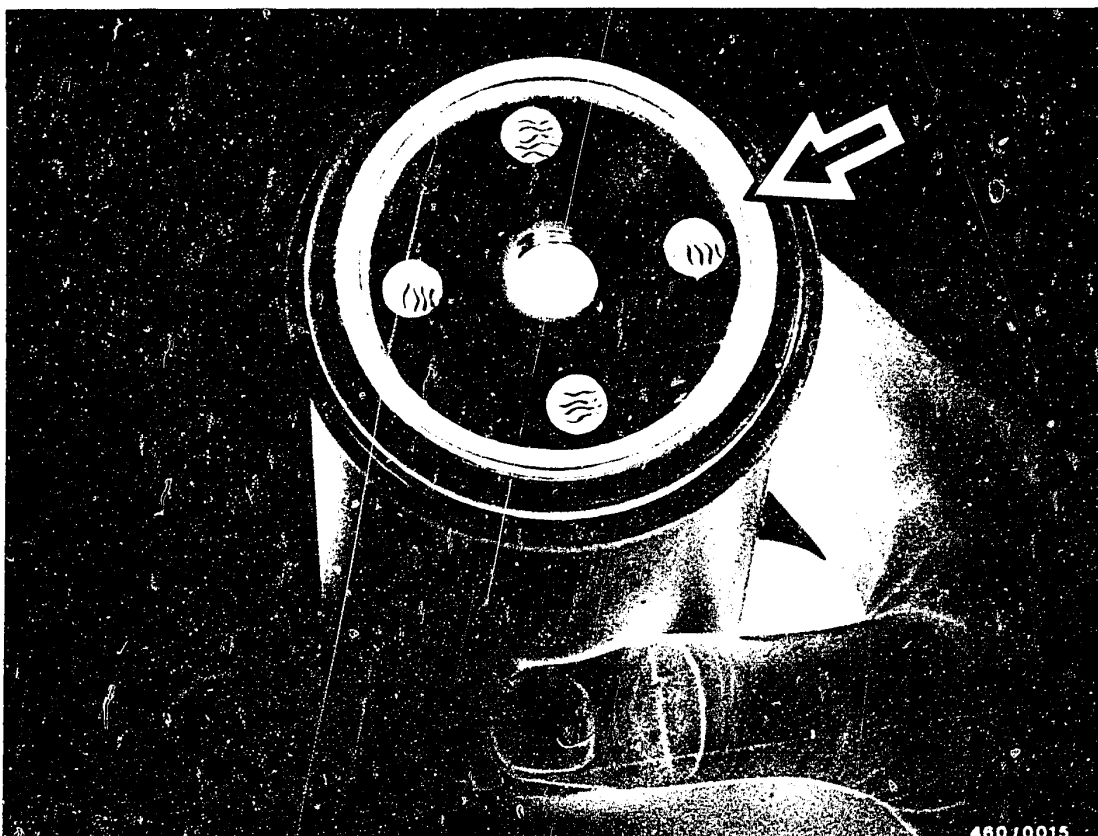
### 19.1 Replace filter box

Unscrew filter box and drain.

If stuck, loosen filter box with special wrench, e.g. Matra W 167.

Catch escaping fuel.





Rub diesel fuel into the rubber seal (arrow) of the new filter box.

Screw the filter box into the cover by hand and tighten.

Check the fuel filter for leaks.

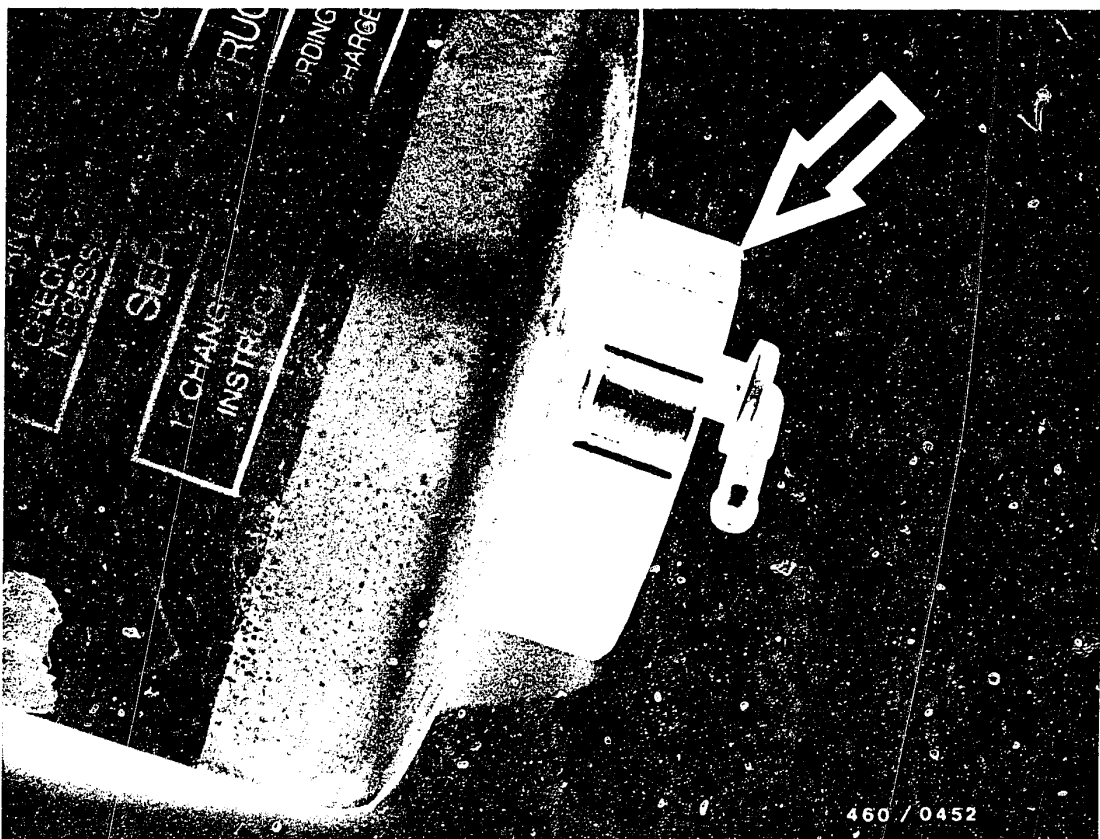
In the case of winter fuel it may be necessary to add petroleum as specified by the vehicle manufacturer.

**B21**

Replace and drain filter box

BMW 524 td





### 19.2 Drain water from fuel filter

Loosen bleeder screw on filter cover by a few turns.

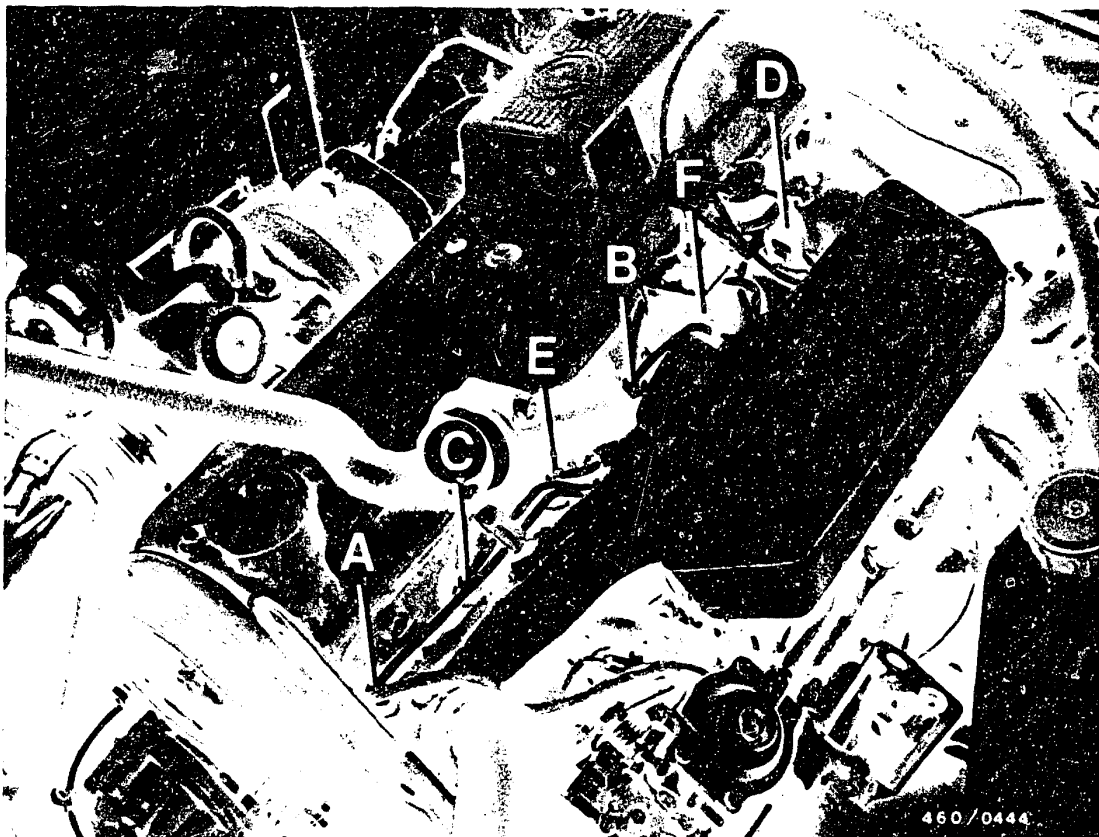
Loosen water-drain plug on base of filter (arrow) and drain water.

Catch liquid in container.

Tighten water-drain screw and bleeder screw and check for leaks.

If necessary, bleed fuel filter.





## 20. CHECK INJECTION SYSTEM FOR LEAKS

Perform leak test with engine at normal operating temperature.

Check all fuel line connections.

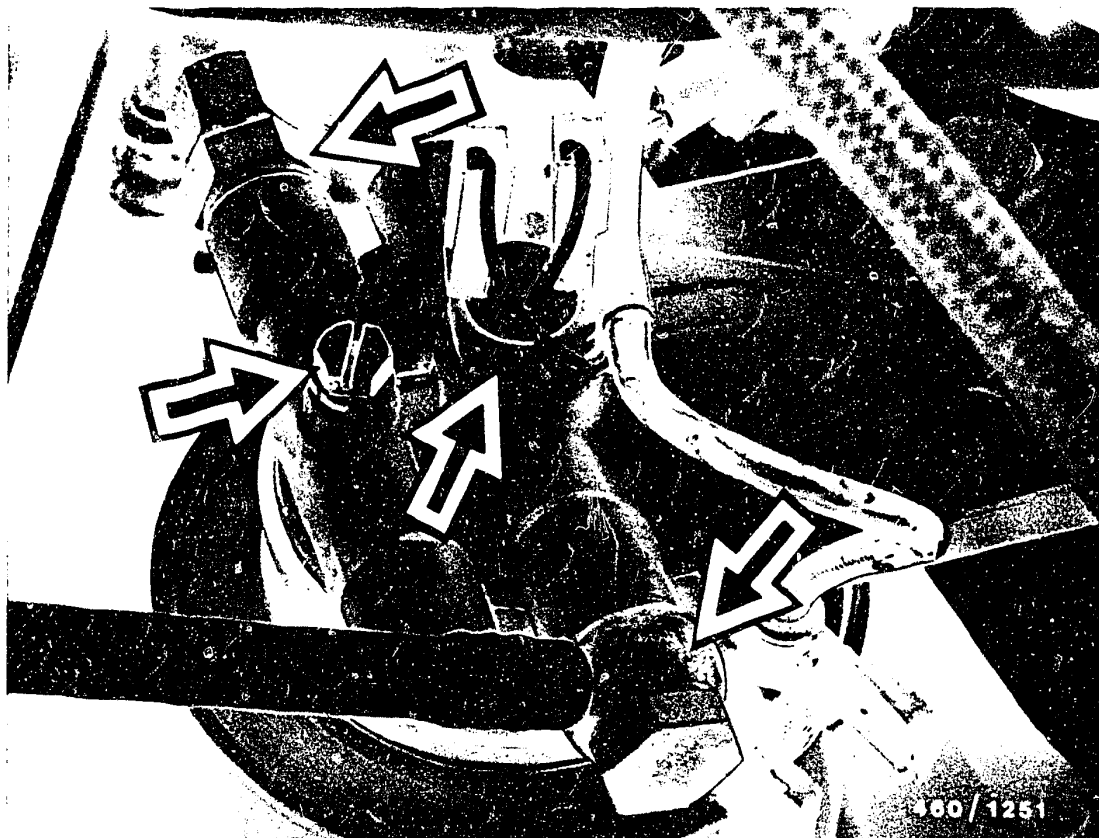
Pay particular attention to:

- Connections at injection-nozzle holders (A...F).

**C1**

Check injection system for leaks  
BMW 524 td





- Connections and screw-connections on fuel filter (arrows).

**C2**

Check injection system for leaks  
BMW 524 td

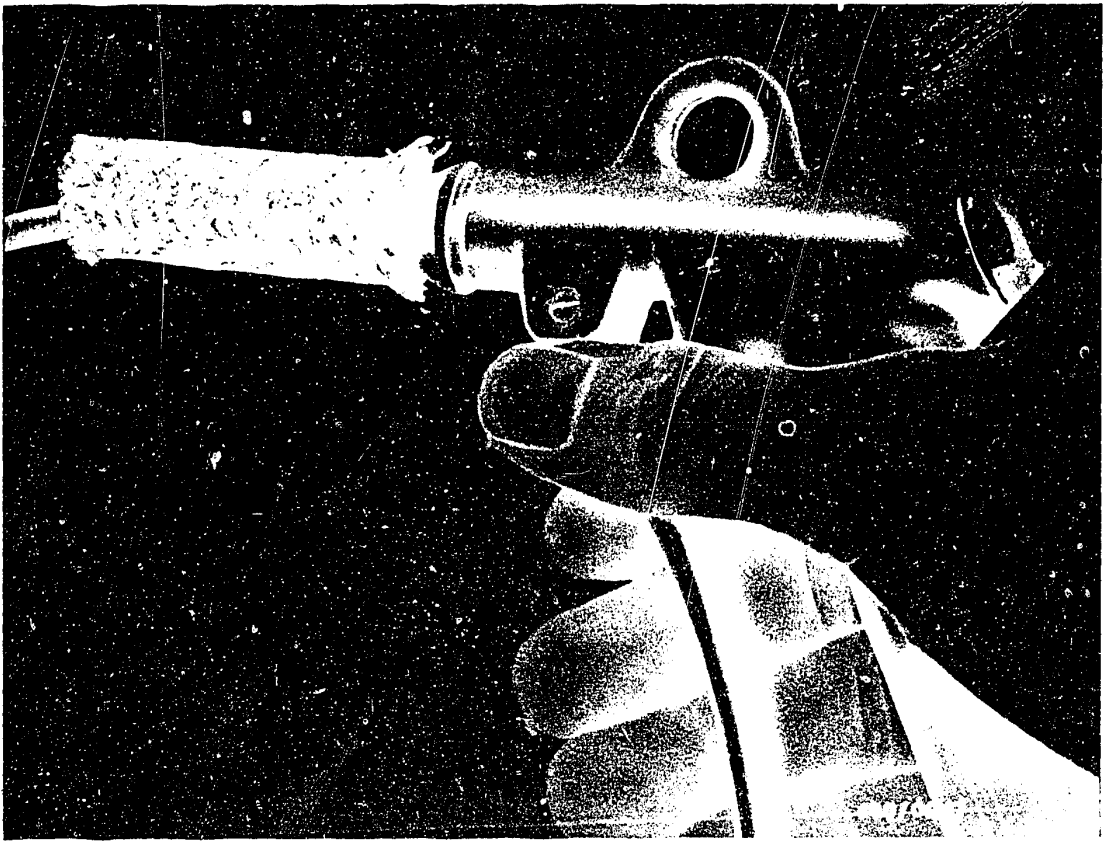




- Inlet and return lines on distributor-type fuel-injection pump (arrows).
- Delivery-valve holders on hydraulic head.

Perform visual inspection of fuel lines for hairline cracks.





#### 21. CHECK FUEL LINES

Subject suspect fuel lines to a visual inspection.

If there is no detectable pinching or kinking, the fuel line in question must be removed.

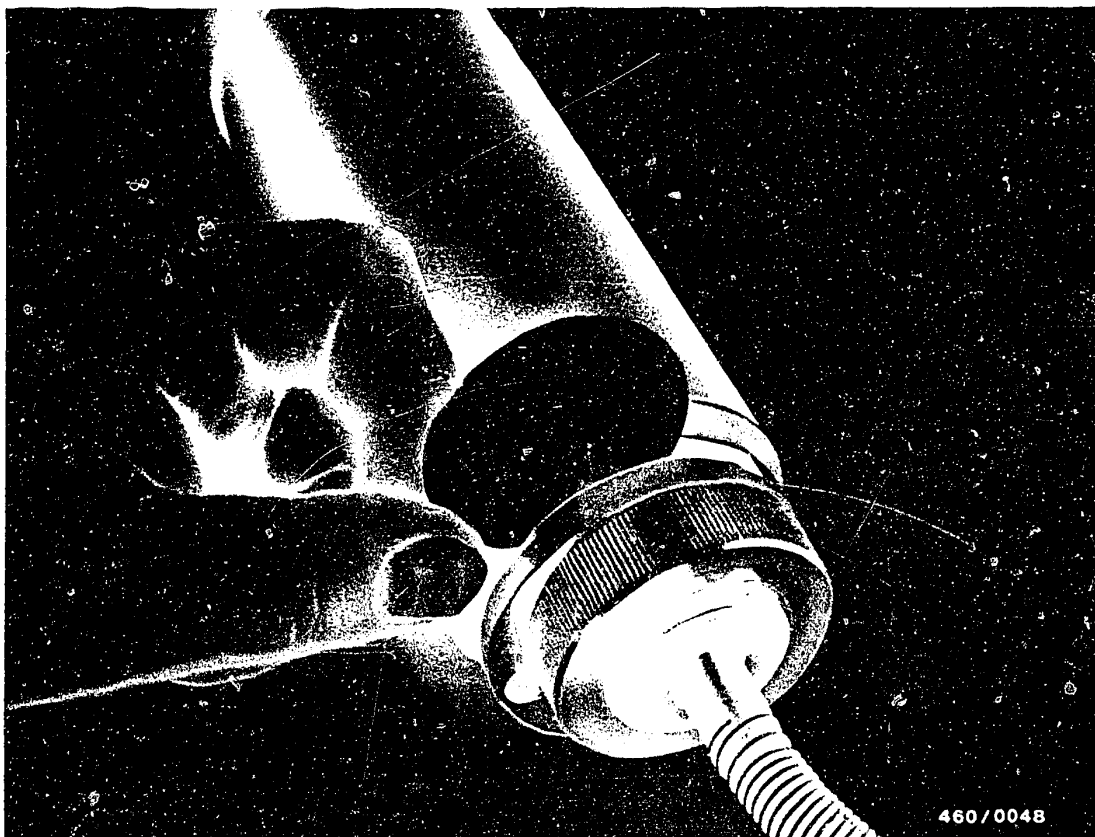
Check fuel line for throughflow using compressed air and clean if necessary.

A suitable hose piece may be used as a side seal, for blowing out the fuel lines.

**C4**

Check fuel lines  
BMW 524 td





## 22. SMOKE TEST - CHECK AIR FILTER

### 22.1 Test setup

The smoke test is conducted using the Bosch filter-type smokemeter.

The filter-type smokemeter consists of the following units:

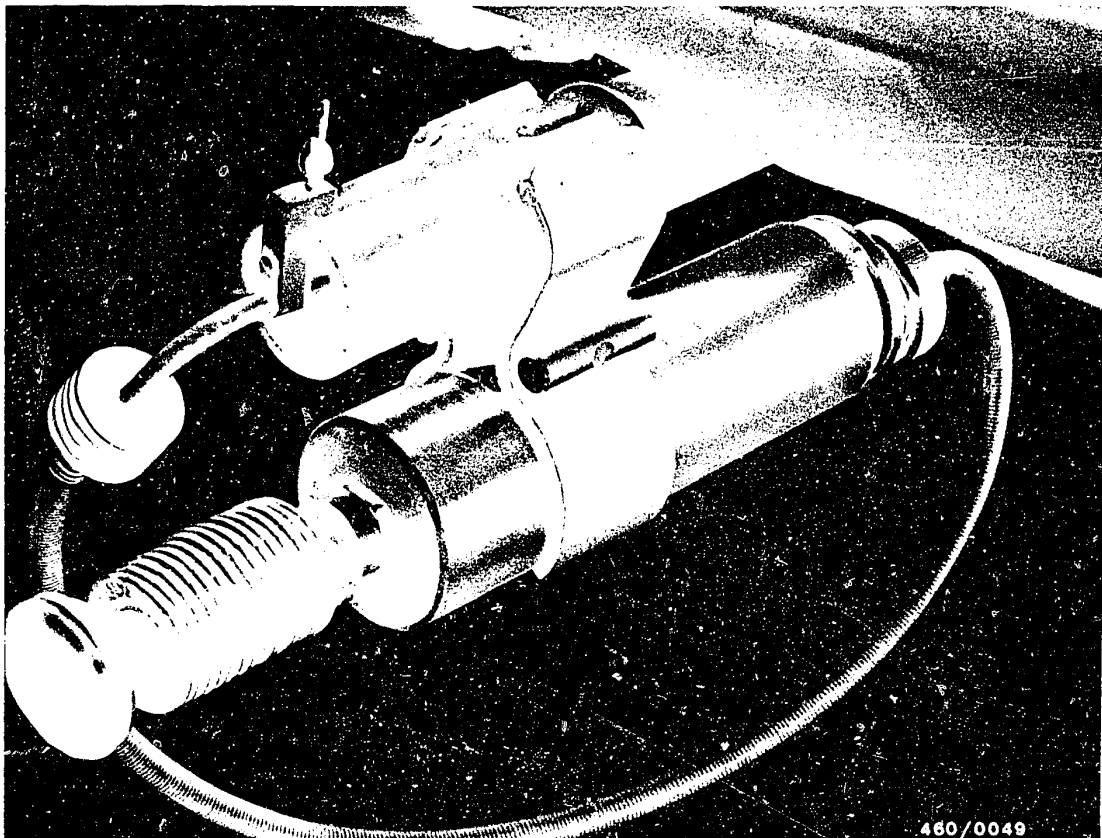
Accessories box with proportioning pump	0 681 169 038
---	---------------

Evaluating unit	0 684 102 050
-----------------	---------------

Insert filter plate into proportioning pump.







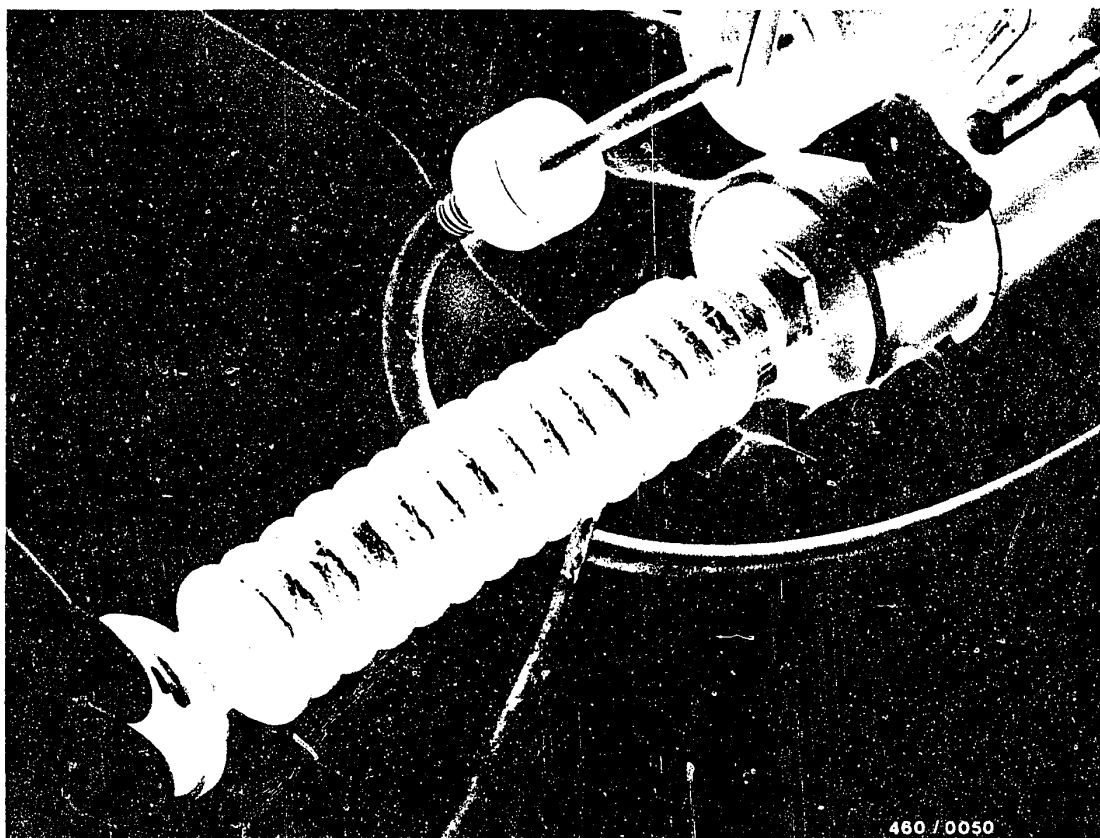
Mount sampling pump on exhaust pipe using appropriate clamp.

Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.

**C6**

Smoke test  
BMW 524 td





### 22.1.2 Test procedure

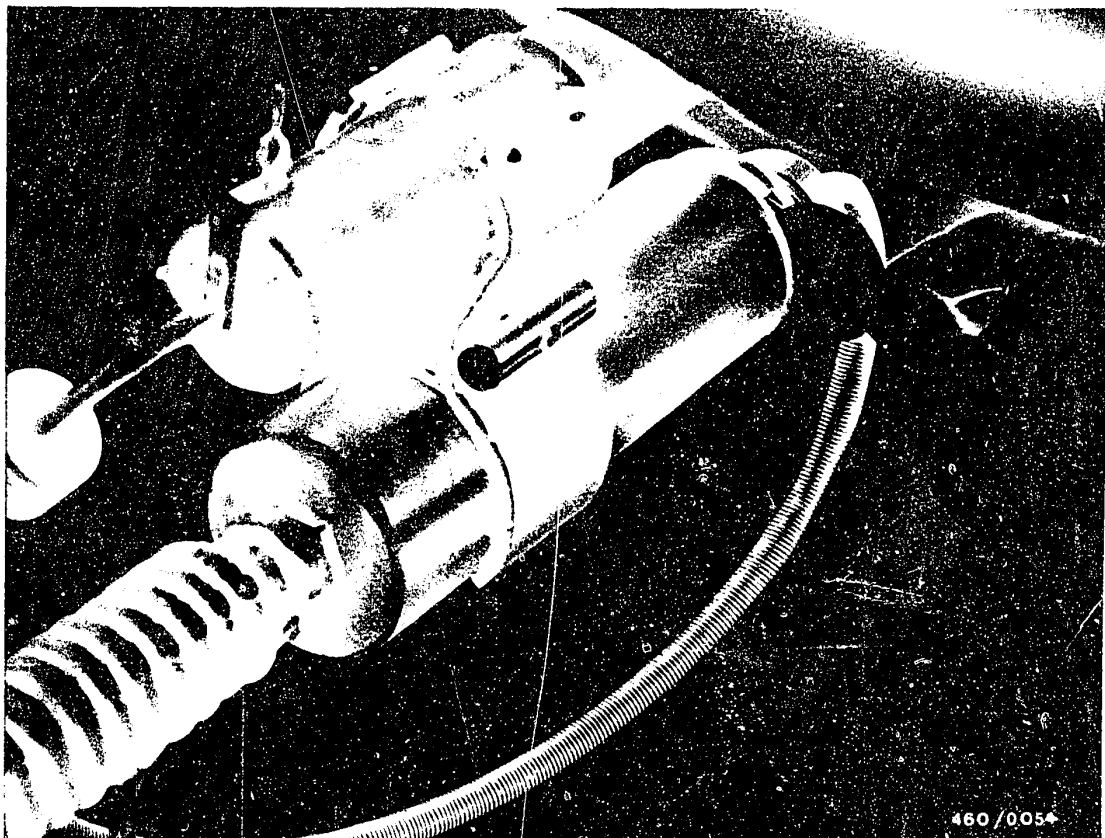
Set proportioning pump by pressing in the black push-button.

Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient).

The chassis dynamometer is preferable in any case. Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 25 km/h is reached.





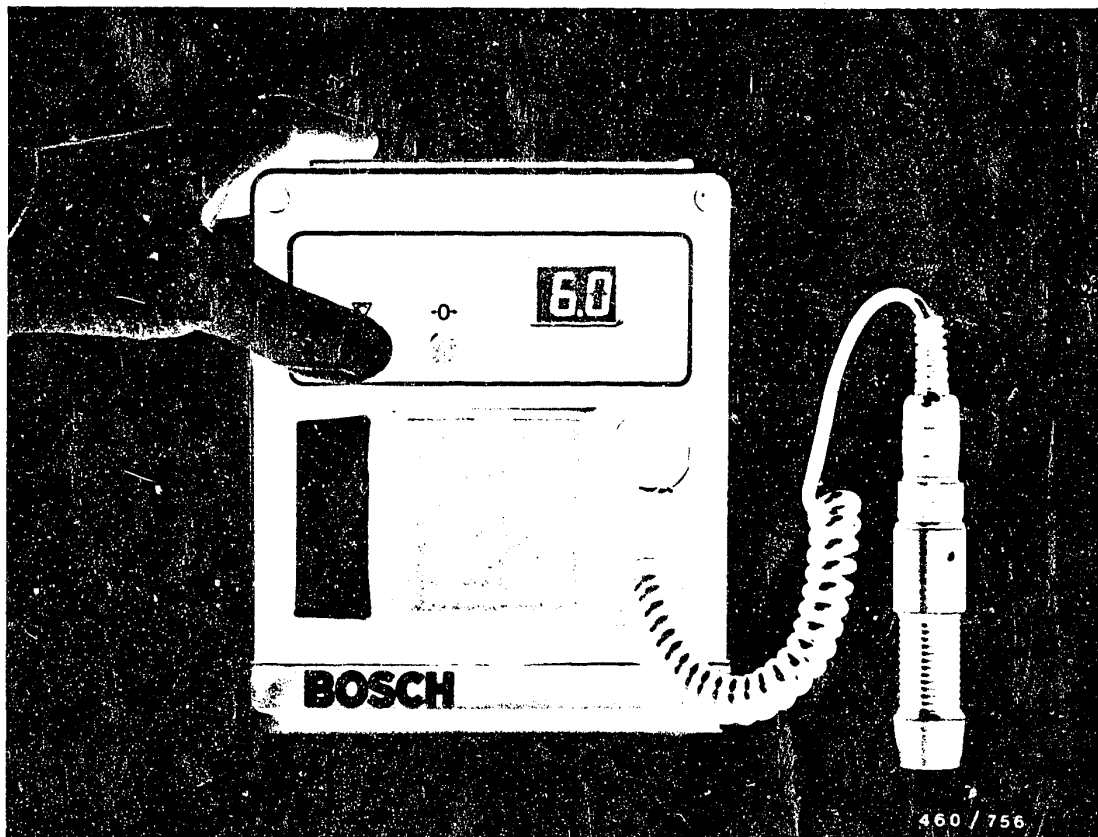
Maintain this load condition for 5 seconds and then trigger the sampling pump by pressing the rubber ball.

Switch off engine.

Caution!

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove filter plate from sampling pump.



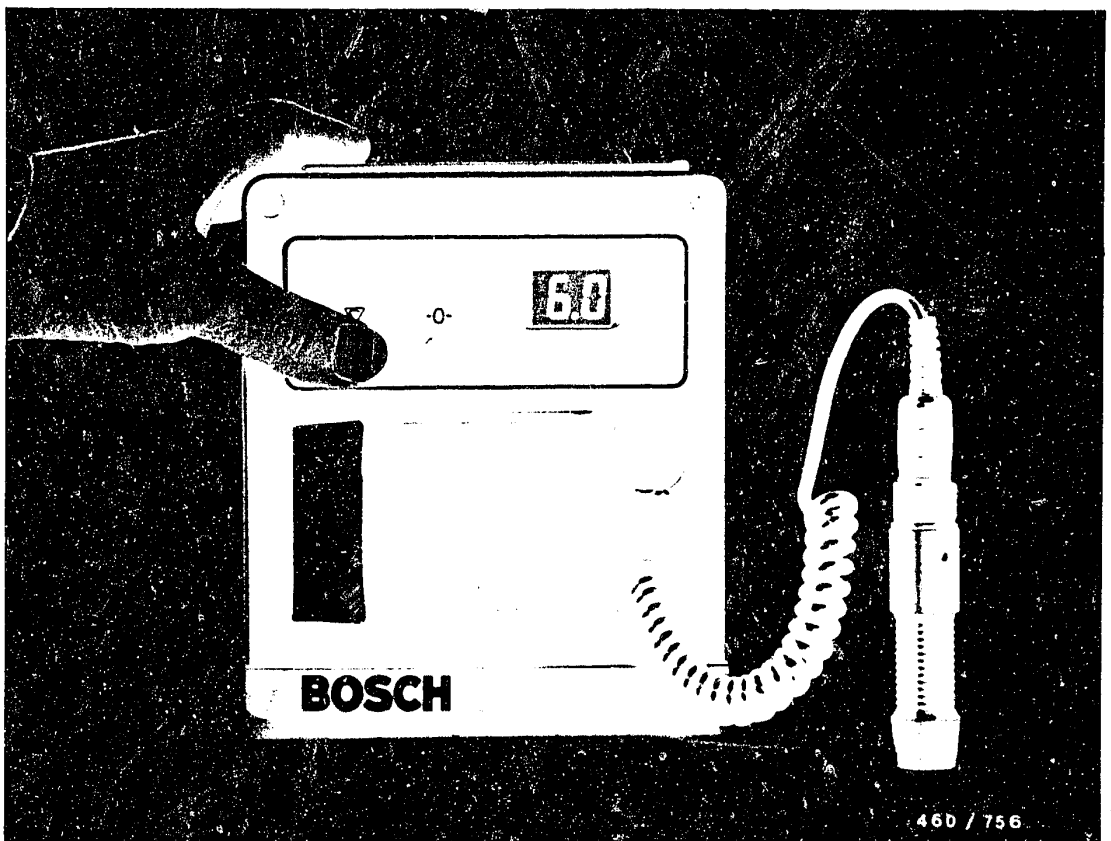
### Setting the Zero Point

The zero point adjustment must be performed

- before each measurement series
- if there are changes in ambient conditions
- each time the lens of the photo-element adapter has been cleaned.

Firmly press the measuring head of the photo-element adapter onto 5 clean, white filter plates placed one on top of the other.

Press button "0" until display 0.0 appears.  
Release button "0".



### Measuring

With the sooted side at the top, lay filter plate from metering unit on 3 new filter plates placed one on top of the other.

Press measuring head vertically on to black surface of filter plate. At the same time, press button "C" until smoke number appears in display.

### Note:

Measuring head must be firmly mounted both for the zero point adjustment and for measuring (even slight tilting may lead to incorrect measurements).

Compare the smoke number with the evaluation sheet.  
Note kW (HP) information of vehicle manufacturer.

**C10**

Smoke test

BMW 524 td



## 22.2 Check air filter

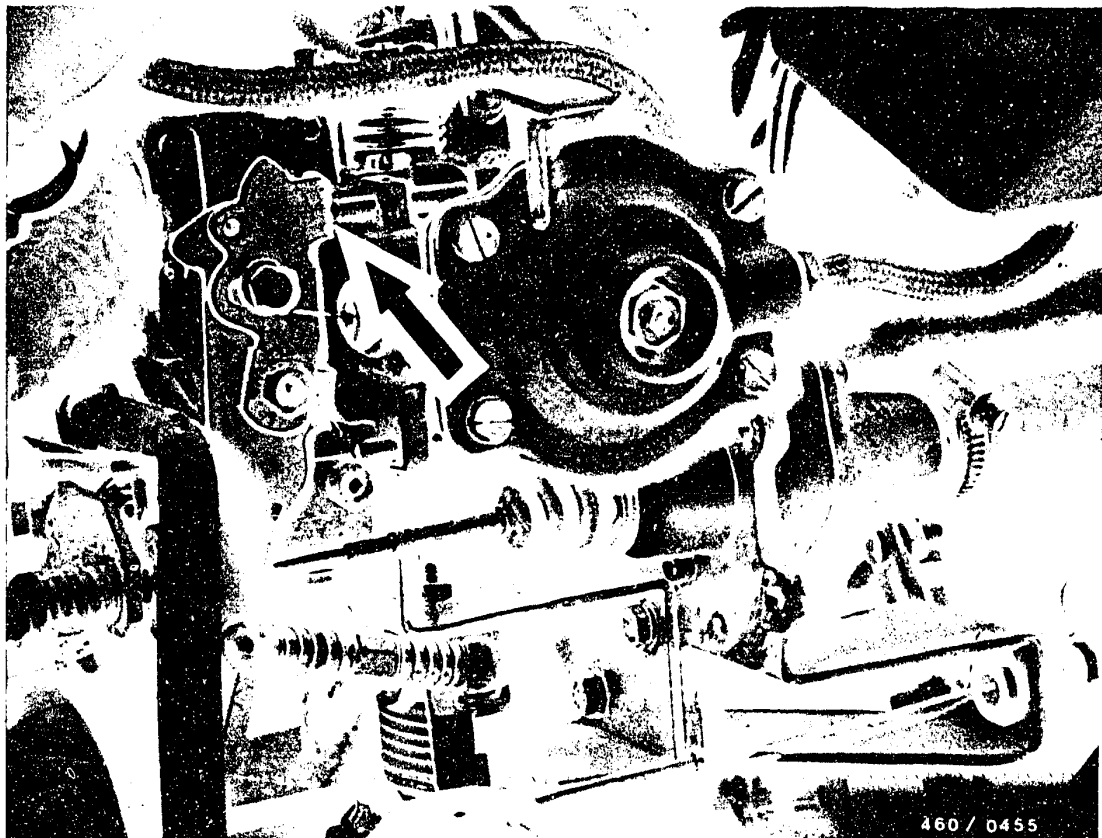
Remove air filter and subject to a visual inspection.

### Test criteria for air filter:

- If air filter dusty - knock out
- If air filter oil-fouled - replace
- Solid parts in air filter (e.g. leaves) - remove.

If in doubt, use new filter element.





### 23. ADJUST IDLE SPEED (for vehicles with manual and automatic transmissions)

Connect a tachometer (e.g., photoelectric) to the engine. To do so, put reflection mark on the crankshaft. Align a manual digital tachometer to the reflection mark and scan the engine speed optically. Start the engine and have it run at idle speed.

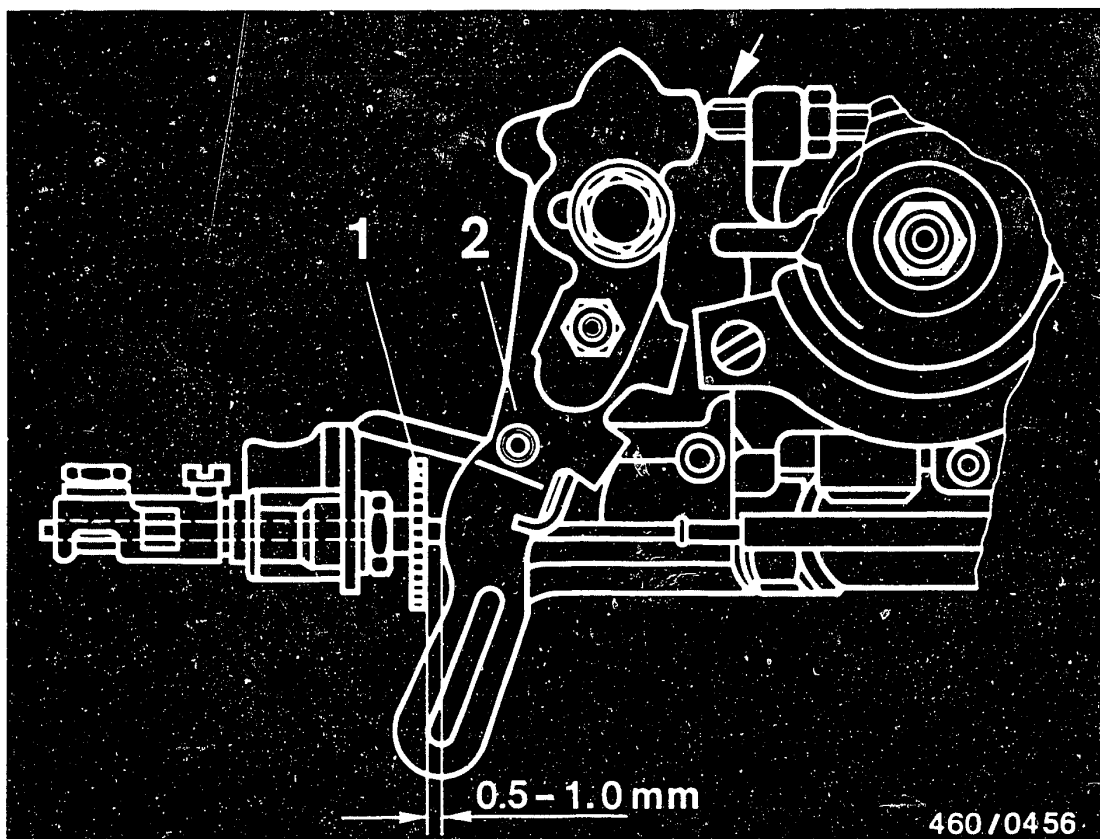
#### C a u t i o n !

For adjusting the idle speed, the engine must be at normal operating temperature (engine temperature  $+60^{\circ}\text{C}$ ).

The temperature-controlled idle-speed increase must be switched off.

The control lever is up against the idle-adjusting screw (arrow).





1 = Knurled thumbscrew

2 = Control lever

Adjust engine speed at the idle-adjusting screw (arrow) to  $750 \pm 50 \text{ min}^{-1}$ .

Turn the knurled thumbscrew until there is a clearance of from 0.5 - 1.0 mm between the control lever and the knurled thumbscrew.

Note :

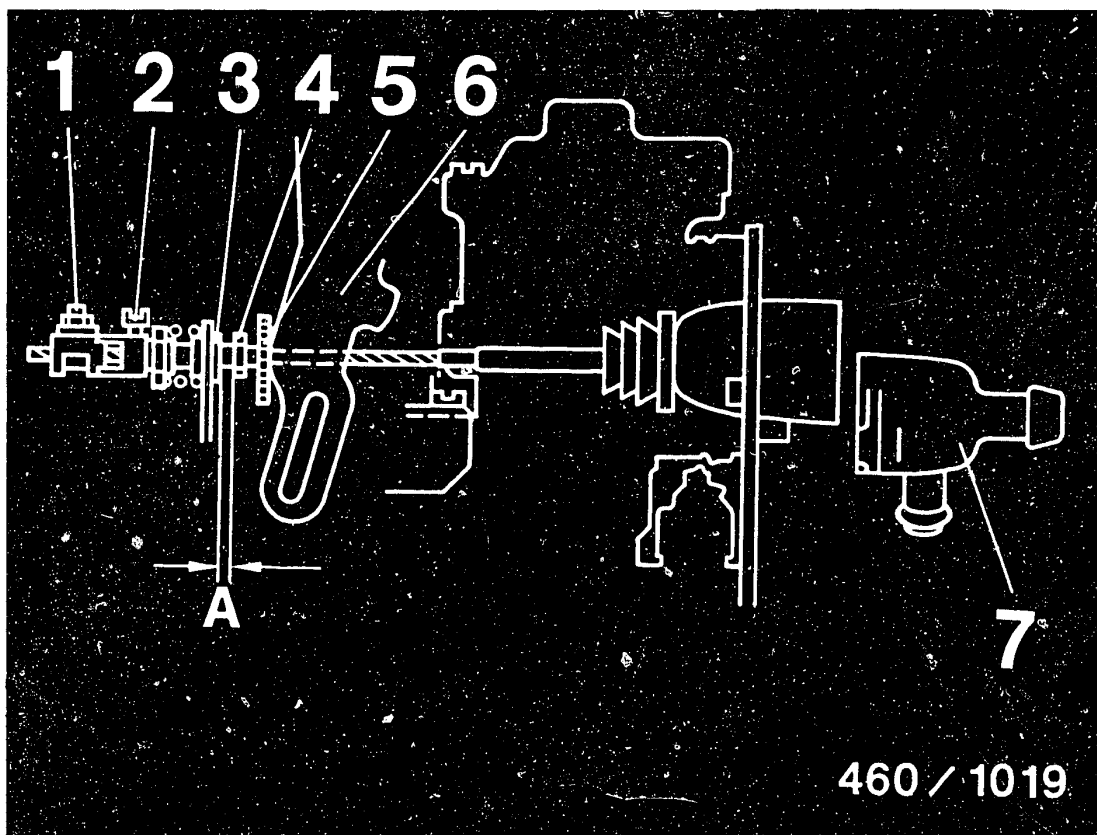
The engine camshaft and fuel-injection pump are driven at half the engine speed.

After adjusting, lock the adjusting screw and seal it.

After adjusting the idle speed, check play in cable for accelerator and engine-speed control lever position (only on vehicle with automatic transmission), and adjust if necessary.







### 23.1 Adjusting the idle-speed increase Testing the total travel

Remove the housing of the temperature-controlled idle-speed increase device (7).

Measure dimension "A" between lock nut of knurled screw (4) and collar of holding bracket (3).

Specified value:  $A = 5,1 \dots 5,9 \text{ mm}$

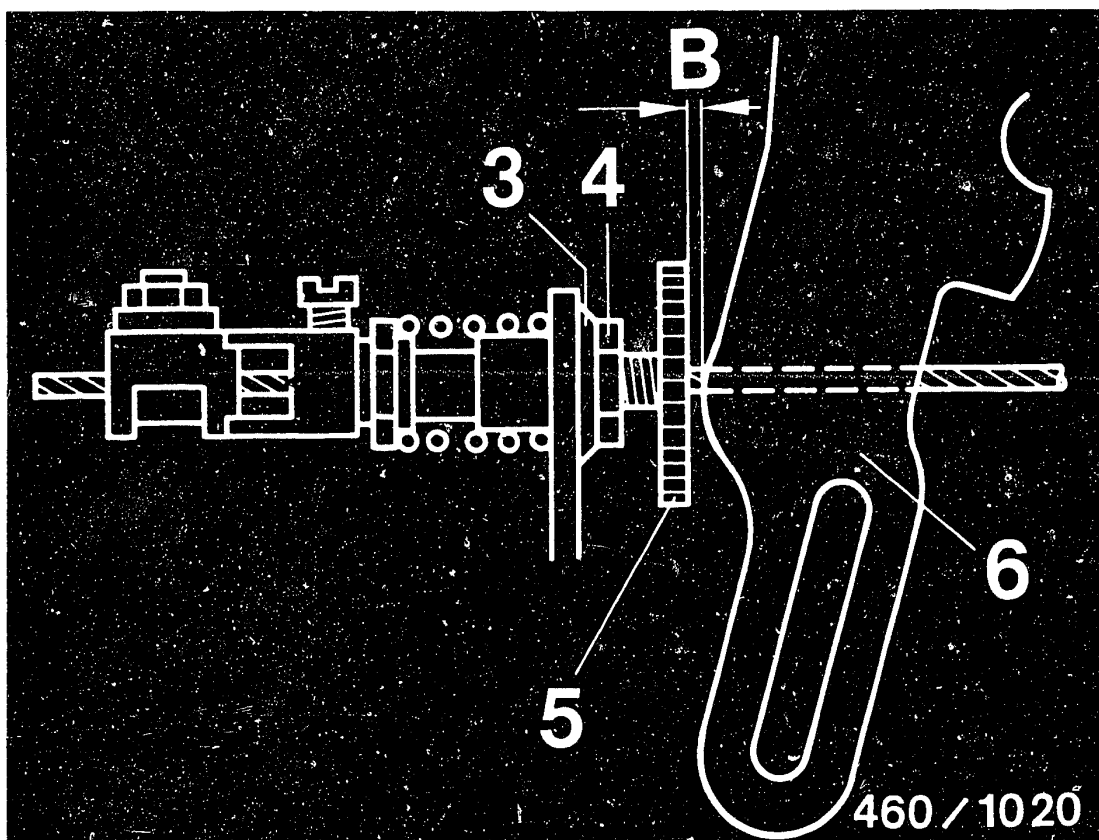
For measurement, the control lever (6) must lie up against the knurled thumbscrew (5).

Adjustment:

Release the clamping piece (1 and 2) and shove far enough so that dimension "A" is within the range of tolerances.

First fasten clamping piece (1), then clamping piece (2).

Put the housing (7) back on.



23.2 Check the distance from the control lever to the  
knurled thumbscrew (adjust)  
Adjustment with engine warm

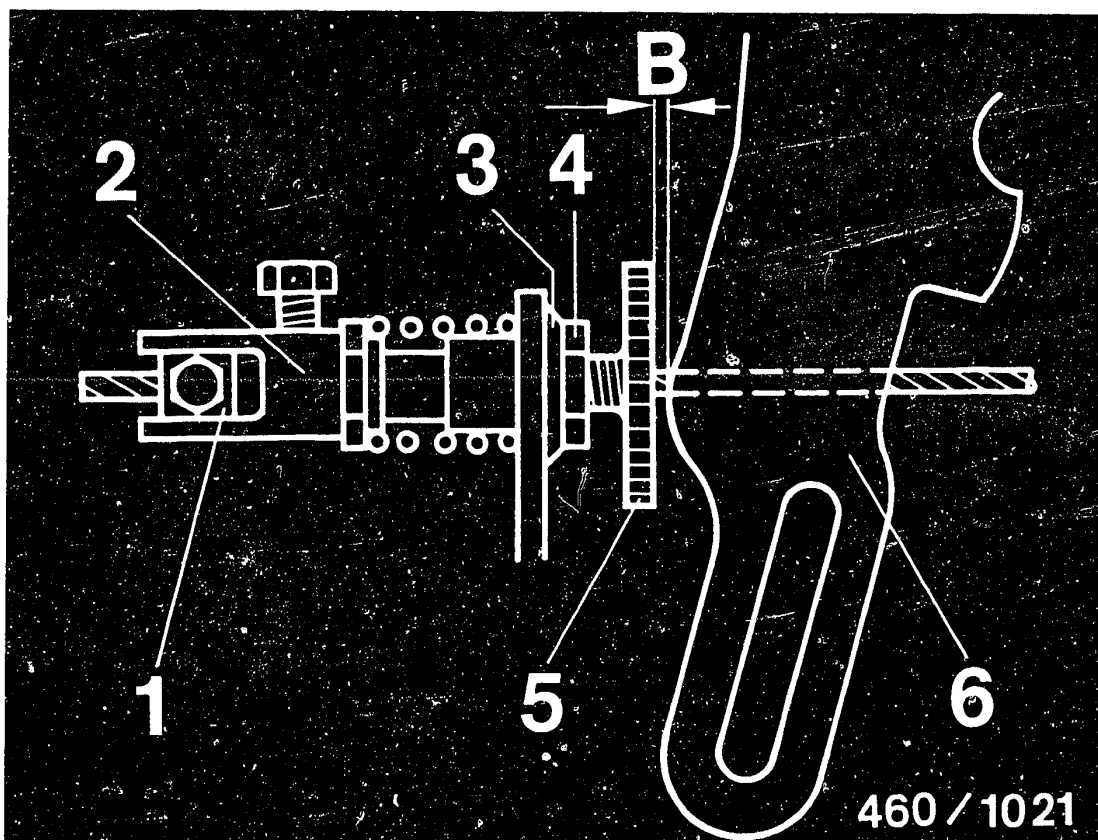
Pre-condition:

- Warm idle adjustment O.K.
- Coolant temperature > 25°C
- Lock nut (4) lies up against the band (3)
- The control lever (6) lies up against the idle  
adjusting screw

Measure distance "B" between the control lever (6) and  
the knurled thumbscrew (8).

Specified value:  $B = 0,2 \dots 0,8 \text{ mm}$

If the specified value is not attained, release the  
lock nut (4) and turn the knurled thumbscrew (5)  
until dimension "B" is within the range of tolerances.



### 23.3 Check distance from the control lever to the knurled thumbscrew (adjust) Adjustment with engine cold

Release clamping piece (2) and turn it by 90°. (Clamping piece (2) slides over clamping piece (1).)

Pre-condition:

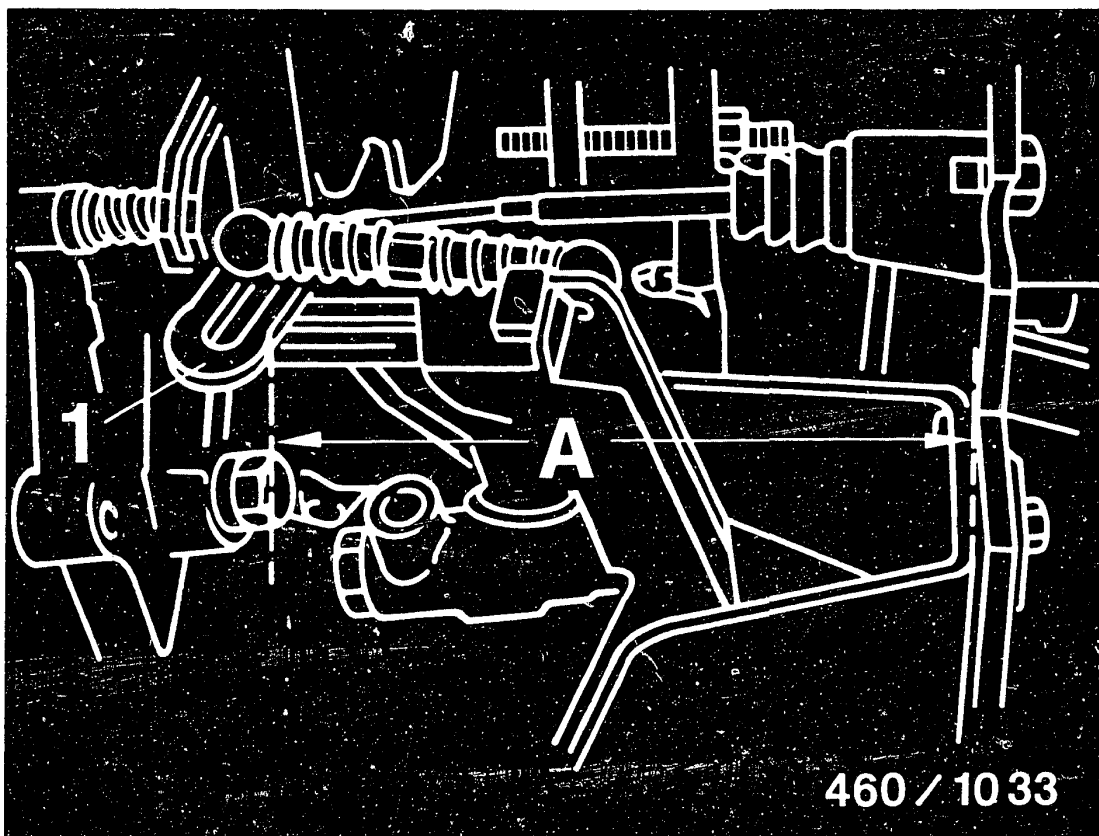
- Warm idle adjustment O.K.
- Lock nut (4) is up against collar (3).
- Control lever (6) lies up against the idle-adjusting screw

Measure distance "B" between the control lever (6) and the knurled thumbscrew (5).

Specified value:  $B = 0,2 \dots 0,8 \text{ mm}$

If the specified value is not attained, release the lock nut (4) and turn the knurled screw (5) until dimension "B" is within the range of tolerances. Turn clamping piece (2) again by 90° and fasten it.





#### 24. ADJUST ENGINE-SPEED CONTROL LEVER

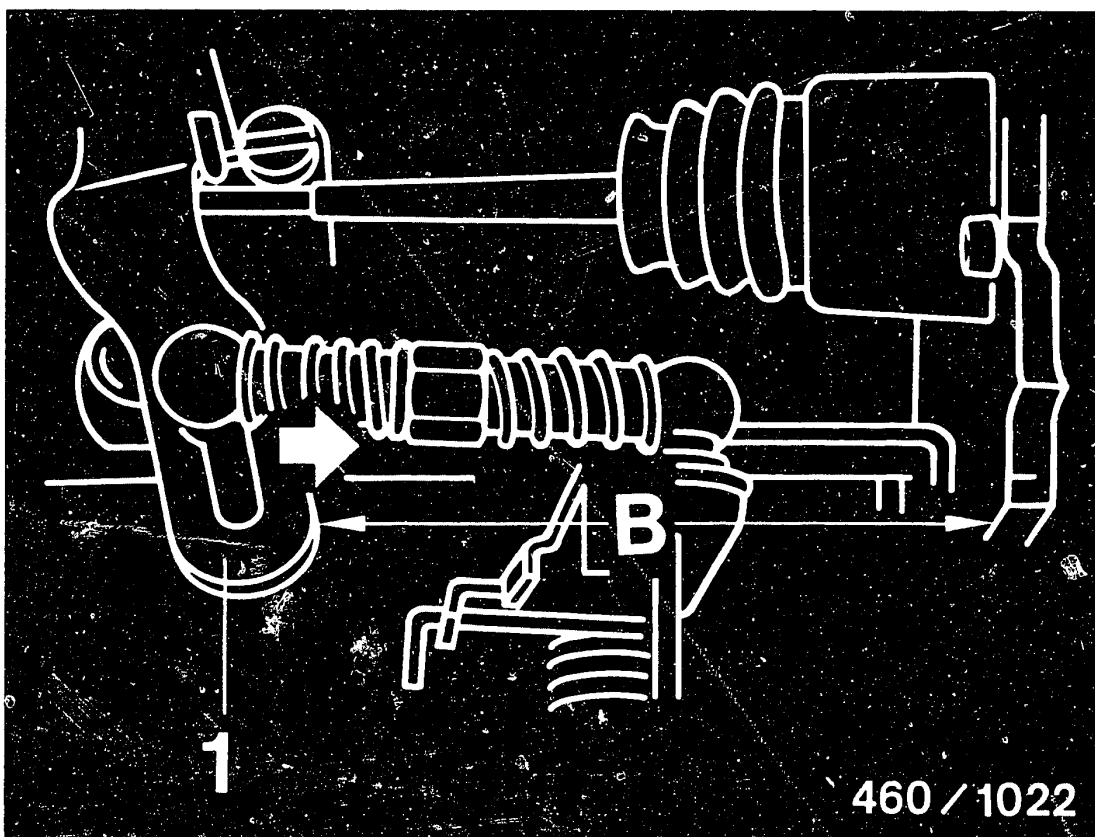
(only on vehicles with automatic transmission)

##### Requirements:

- Idle speed correctly adjusted.
- Engine at normal operating temperature.
- Control lever (1) up against idle stop.

Measure dimension "A" and note down.





Press the control lever (1) against the full-load stop.  
Measure dimension "B" and note it down.

Subtract dimension "B" from dimension "A".  
 $A - B = C$

Example:

$A = 98 \text{ mm}$   
 $B = 47 \text{ mm}$   
 $C = 51 \text{ mm}$

With the value  $C = 51 \text{ mm}$  as calculated,  
dimension "D" is 61.1 mm, from the tab  
table.

Obtain dimension "D" for the adjustment linkage from  
the table below.

## 24.1 Adjustment table:

C (mm)	41	41.5	42	42.5	43	43.5	44	44.5
D (mm)	78.1	77.0	76.0	74.9	73.9	73.0	72.0	71.1

C (mm)	45	45.5	46	46.5	47	47.5	48	48.5
D (mm)	70.3	69.4	68.6	67.8	67.0	66.3	65.6	64.9

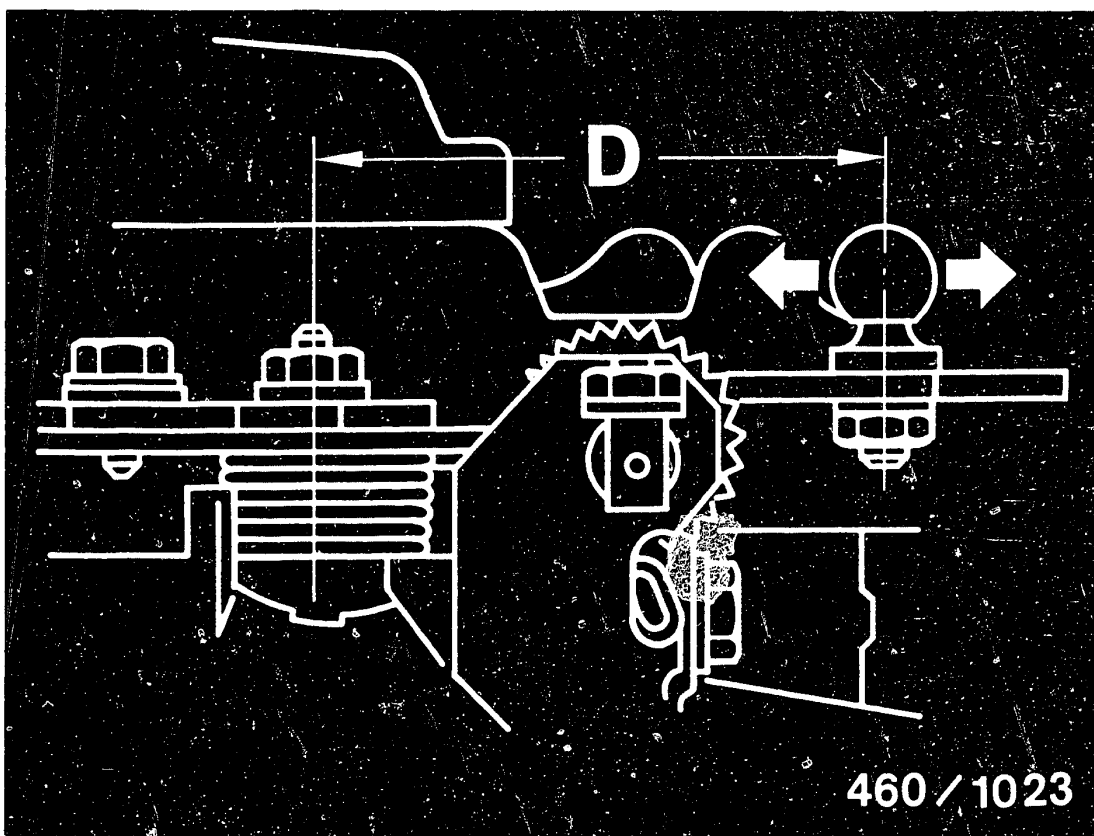
C (mm)	49	49.5	50	50.5	51	51.5	52	52.5
D (mm)	64.2	63.5	62.9	62.3	61.6	61.0	60.5	59.9

C (mm)	53	53.5	54	54.5	55	55.5	56
D (mm)	59.4	58.8	58.3	57.8	57.3	56.8	56.4

**C19**

Put in fuel-injection pump  
BMW 524 td

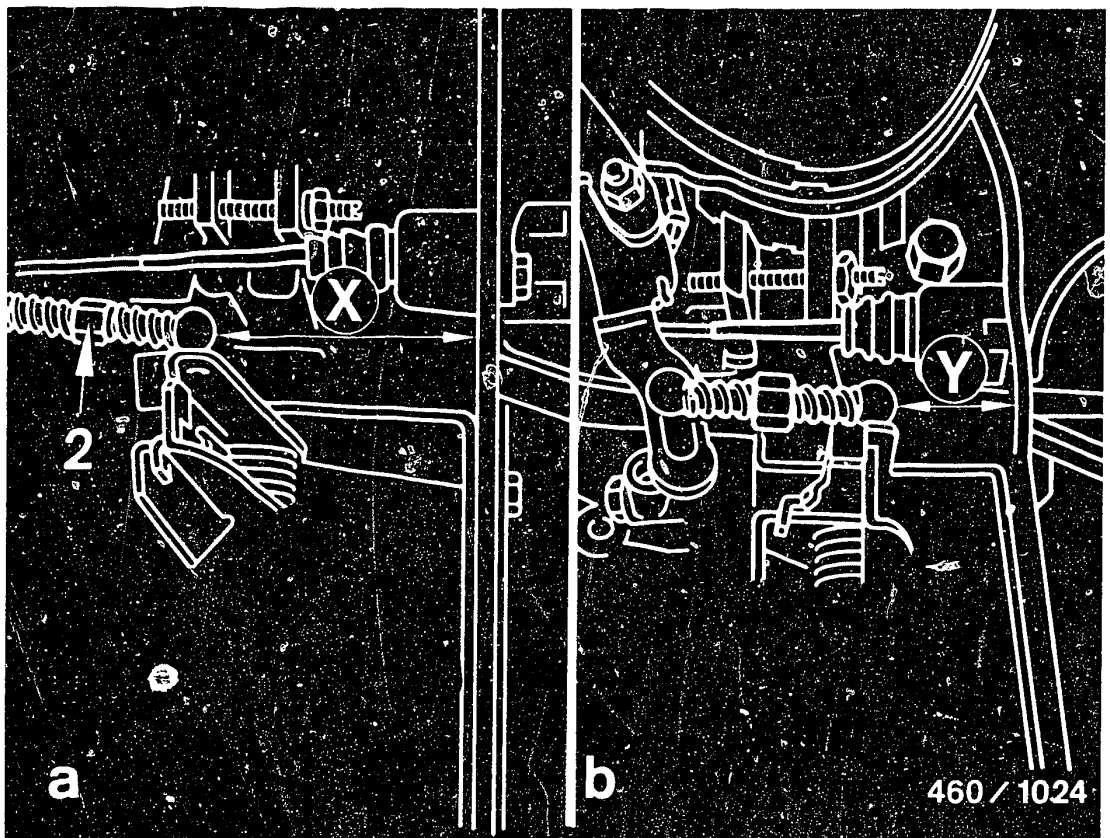




Take out the connection linkage on the control lever.

Measure dimension "D" and compare it to the setting value from the table.

If need be, adjust dimension "D" by changing the position of the ball knob (arrows).



1. Check dimension "X" in the idle setting (Figure a).  
Setting dimension = 68 mm

Adjustment correction on the connecting linkage (2).

2. Check the full-throttle setting (Figure b).

Dimension "Y" must be from 28.5...29.5 mm.

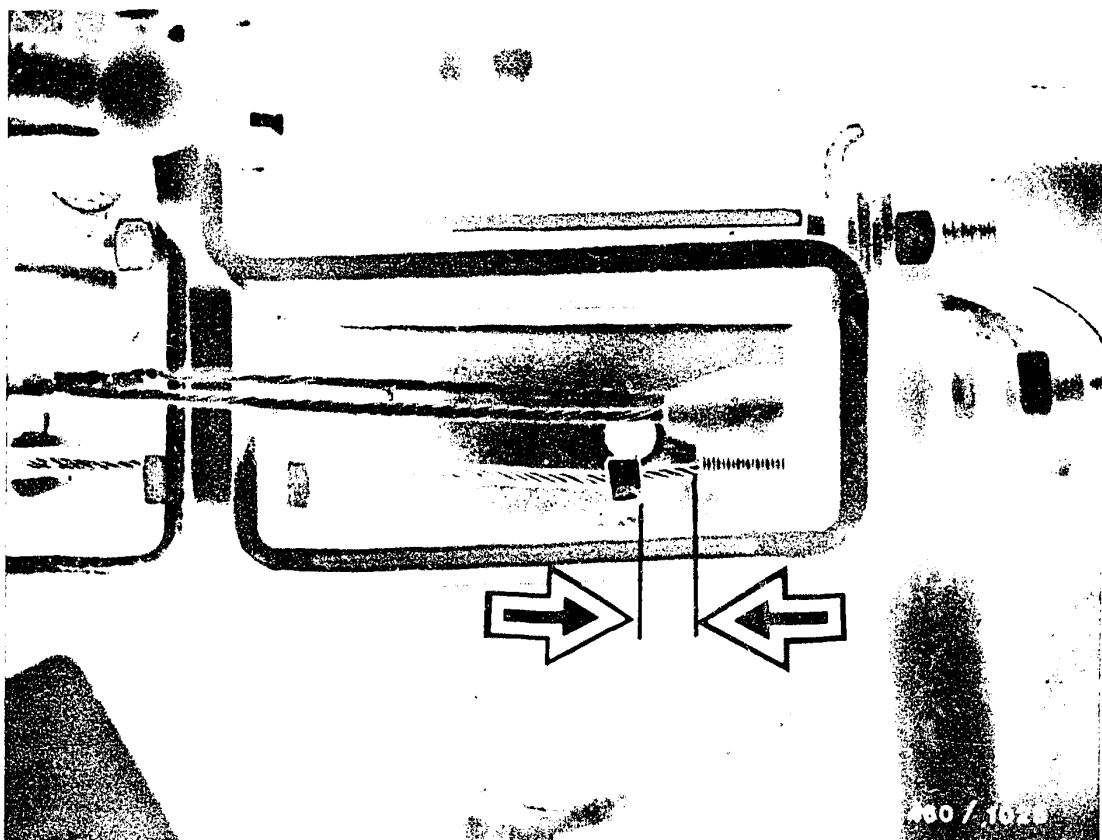
If dimension "Y" is not correct, repeat the entire adjustment.

Note:

After completion of adjusting the engine-speed control lever to the shift position for the automatic transmission, check the cable adjustment for the accelerator pedal lever (adjust).







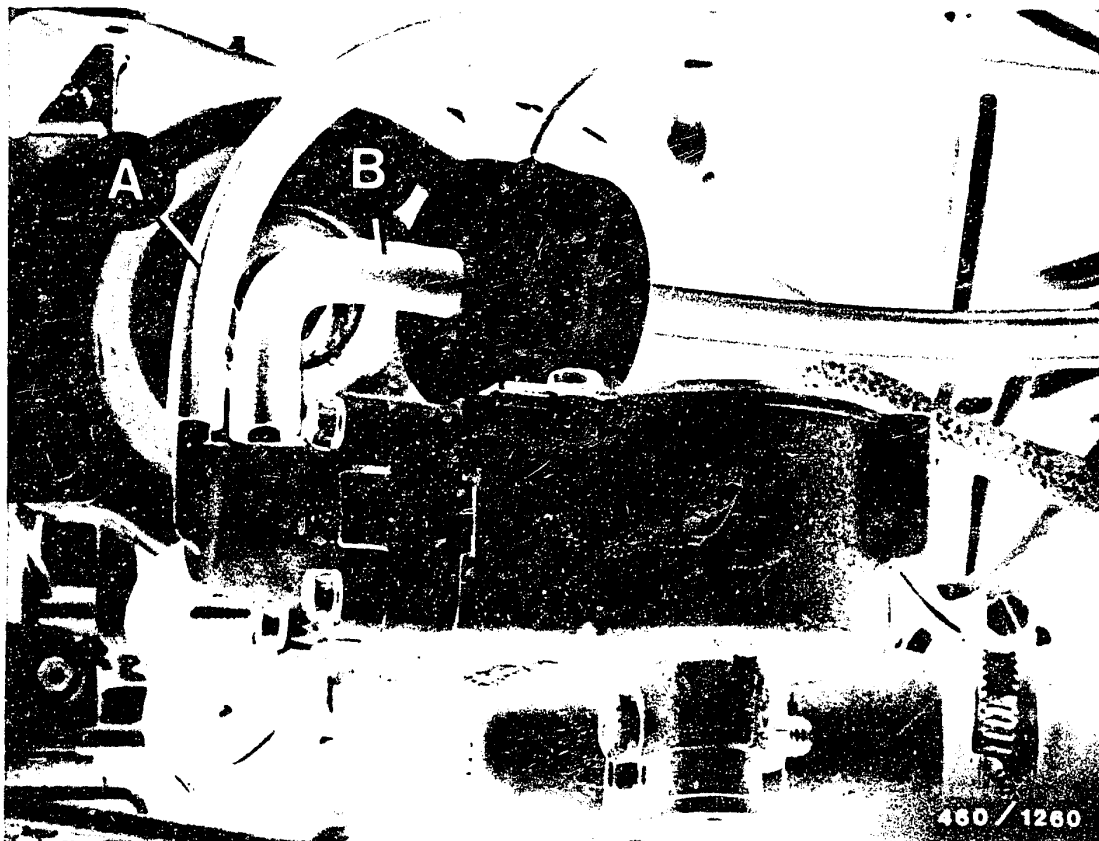
## 25. KICK-DOWN-ADJUSTMENT

Pre-condition:

- Engine at normal operating temperature, coolant temperature  $+80^{\circ}\text{C}$ .

Adjustment:

1. There must be a gap of 0.5 mm present between the cable clamp and the guide sleeve at idle speed.
2. Shut off the engine, step down on the accelerator as far as the kick-down point. Setting dimension between the cable clamp and the guide sleeve = 39 mm. Adjust by changing the guide sleeve.



## 26. TEST AND ADJUST EGR PRESSURE TRANSFORMER

### 26.1 Test pressure transformer

Requirements for testing:

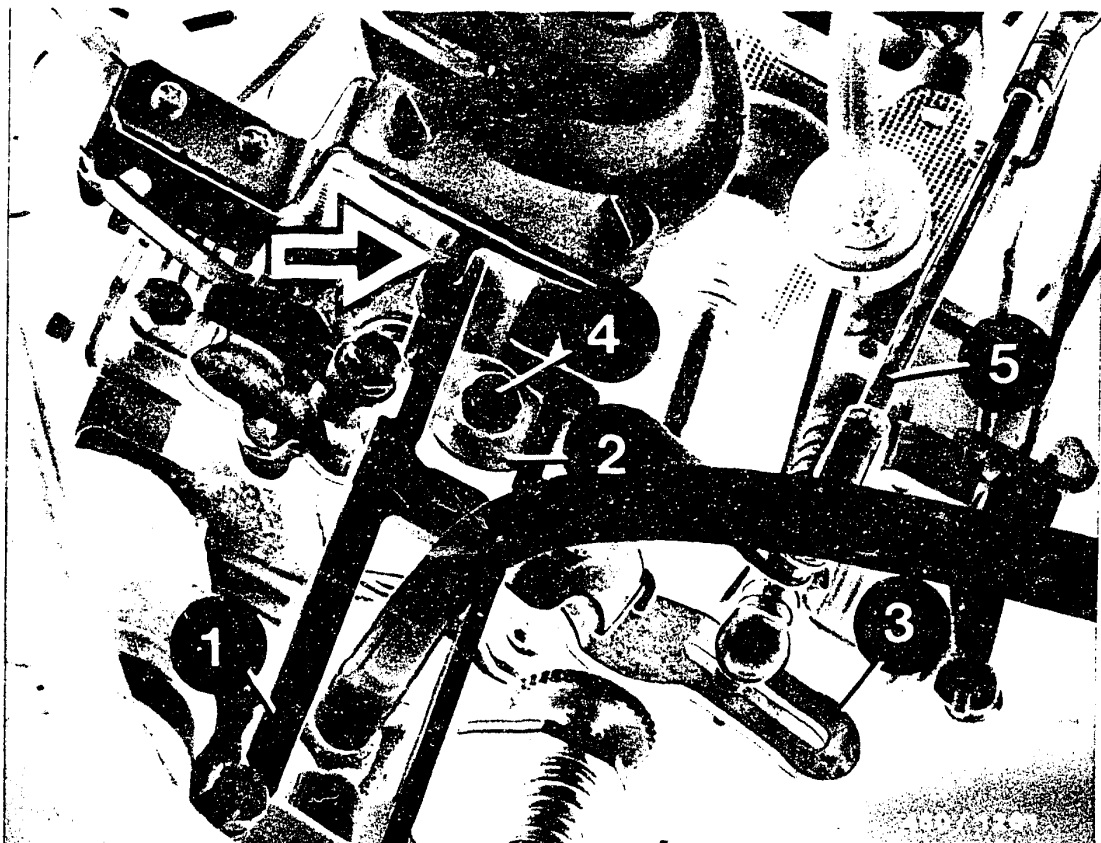
- Idle speed 750...800 min<sup>-1</sup>
- Maximum speed 4800 min<sup>-1</sup>
- temperature-dependent idle increase inoperative (control lever up against idle stop).

Leave on connecting hose (black-red) between vacuum pump (engine) and pressure transformer port "A".

Disconnect vacuum hose (black-blue) from port "B".

Connect vacuum measuring instrument to unoccupied port "B".





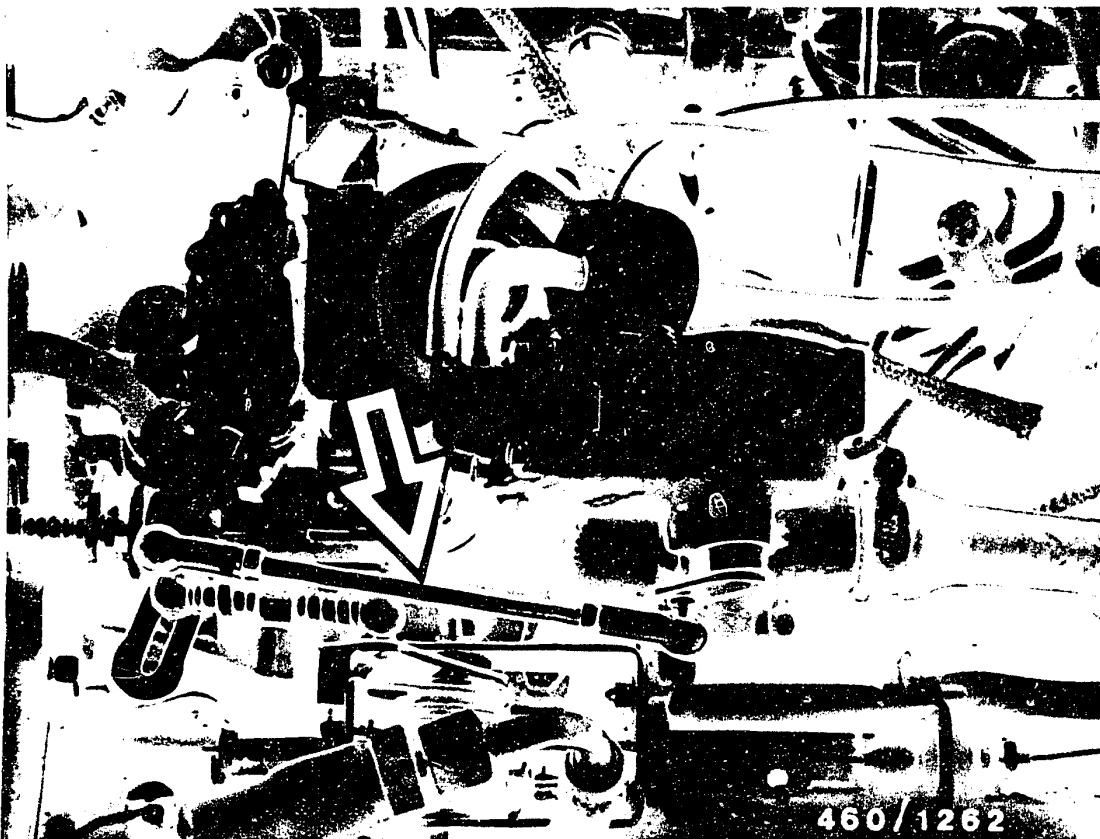
Slide feeler gauge KDEP 1142 (1) over EGR coupling cable (2) and, by turning the control lever (3), fix feeler gauge in web of manifold-pressure compensator housing (arrow).

With the control lever in this position, a setting pressure of 357...363 mbar (checking pressure 350...370 mbar) must be indicated on the vacuum gauge (port "B").

At least 550 mbar must be present as inlet pressure at the pressure transformer (port "A").

Note:

Do not loosen fastening screw (4) of EGR coupling part since otherwise a basic setting from the injection-pump test bench will be necessary.



### 26.2 Adjust pressure transformer

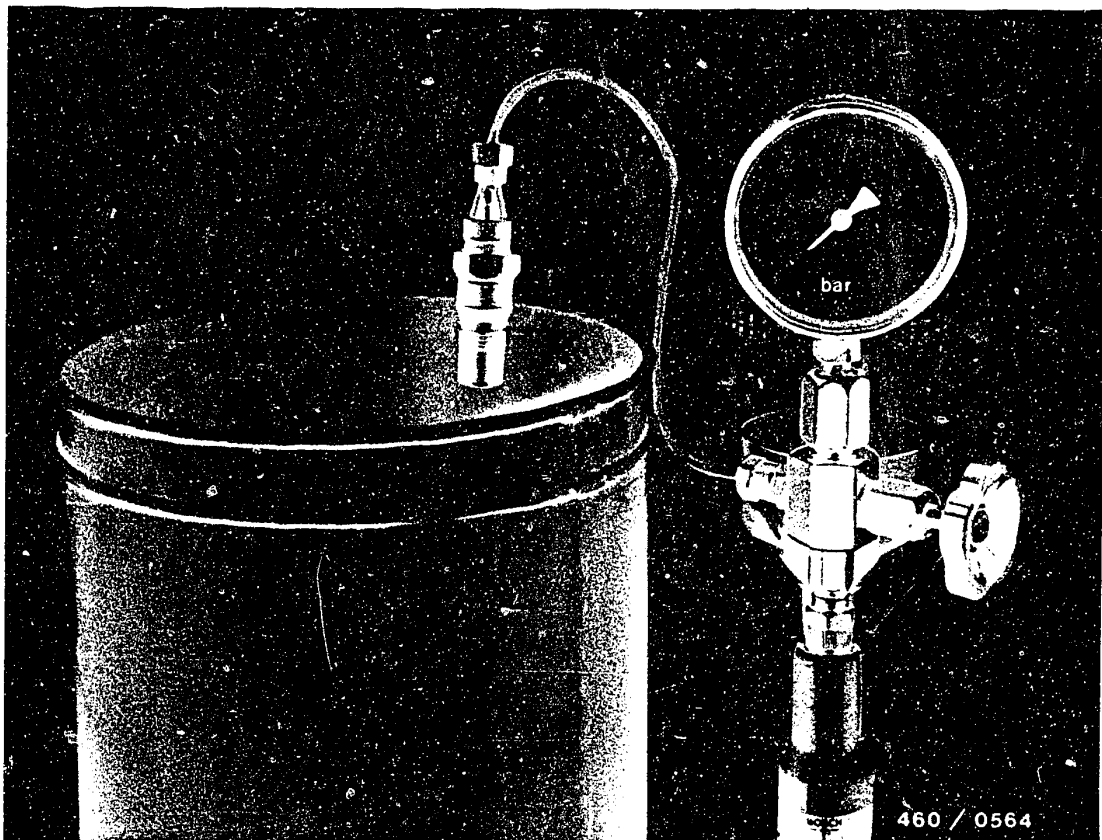
If the control pressure is not obtained, the vacuum can be corrected by changing the length of the connecting rod (arrow).

Shortening = Raising of control pressure

Lengthening = Reducing of control pressure

After tightening the lock nuts (connecting rod), check the adjustment again.





## 27. TEST INJECTION NOZZLES

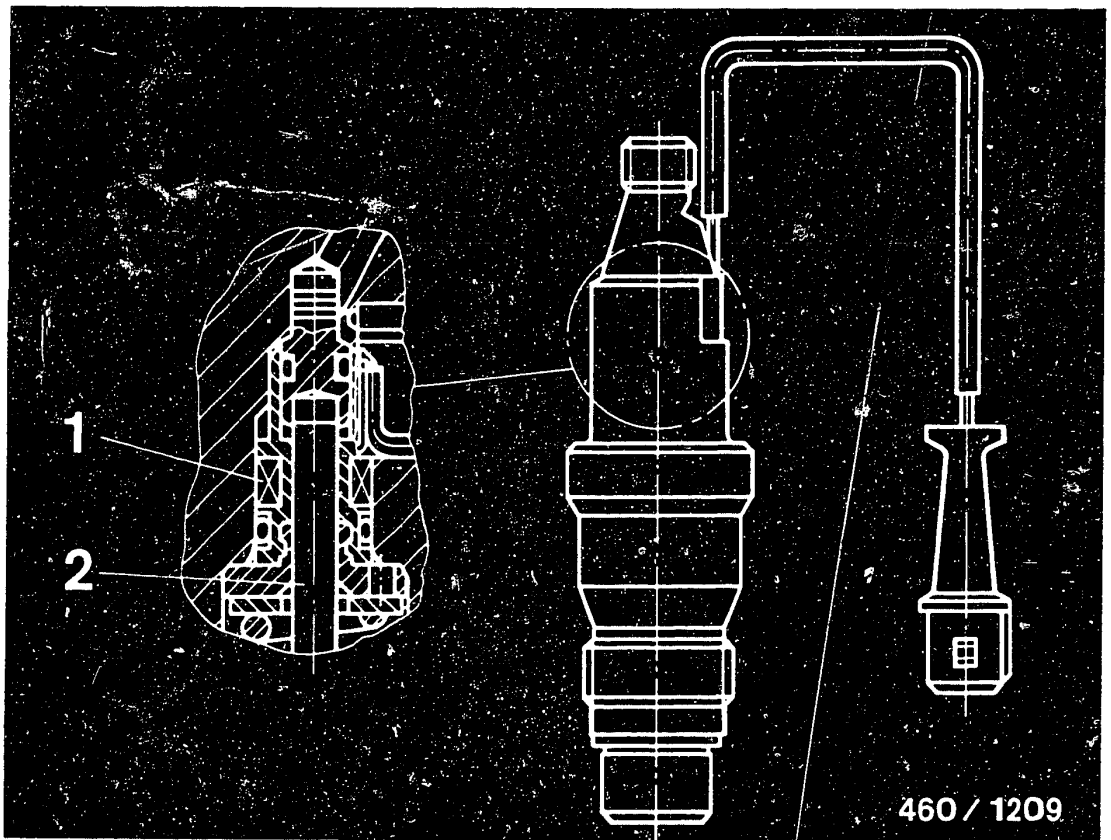
Remove injection nozzles.

The test is performed using the nozzle tester EFEP 60 H 0 681 200 502.

Mount injection nozzle with nozzle-holder assembly on nozzle tester.

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.





- 1 = Needle-movement sensor  
2 = Thrust pin

#### 25.1 Nozzle holder with inductive needle-movement sensor (cylinder 4)

The after-sales service is allowed only to correct the opening pressure. If a nozzle is defective, replace the complete nozzle holder assembly.

Special adjusting shims must be used due to the larger diameter of the central bore.

## Principle of needle-movement sensor

An applied d.c. voltage is regulated such that there is a constant current irrespective of temperature changes. The thrust pin (2) changes a gap in this magnetic circuit, which leads to a change in the magnetic flux and thus to a signal voltage which is induced in the coil. The amplitude of the signal voltage is proportional to the rate of change of flux, which, in turn, is determined by the speed of the thrust pin and by the geometry of the gap.

The signal curve is considerably influenced by the sensor gap. This is governed by the following:

- Holder
- Adjusting pin
- Thrust pin
- Intermediate washer
- Nozzle

When nozzle components are replaced, this changes the sensor gap, which leads to a change in the signal voltage and to incorrect evaluation by the control unit.

For this reason, it is not allowable to replace nozzle components.



### Instructions:

When checking fuel-injection nozzles, make certain that the fuel jet does not strike your hands, because, due to the high pressure, the fuel penetrates into the skin and can cause blood poisoning.

For testing, use pure calibrating oil per ISO 4113 or clean diesel fuel.

### Test criteria:

- Opening pressure
- Leaks
- Chatter
- Spray pattern

### 27.2 Checking opening pressure

Open the spray valve on the pressure gauge by approx. 1/4 turn.

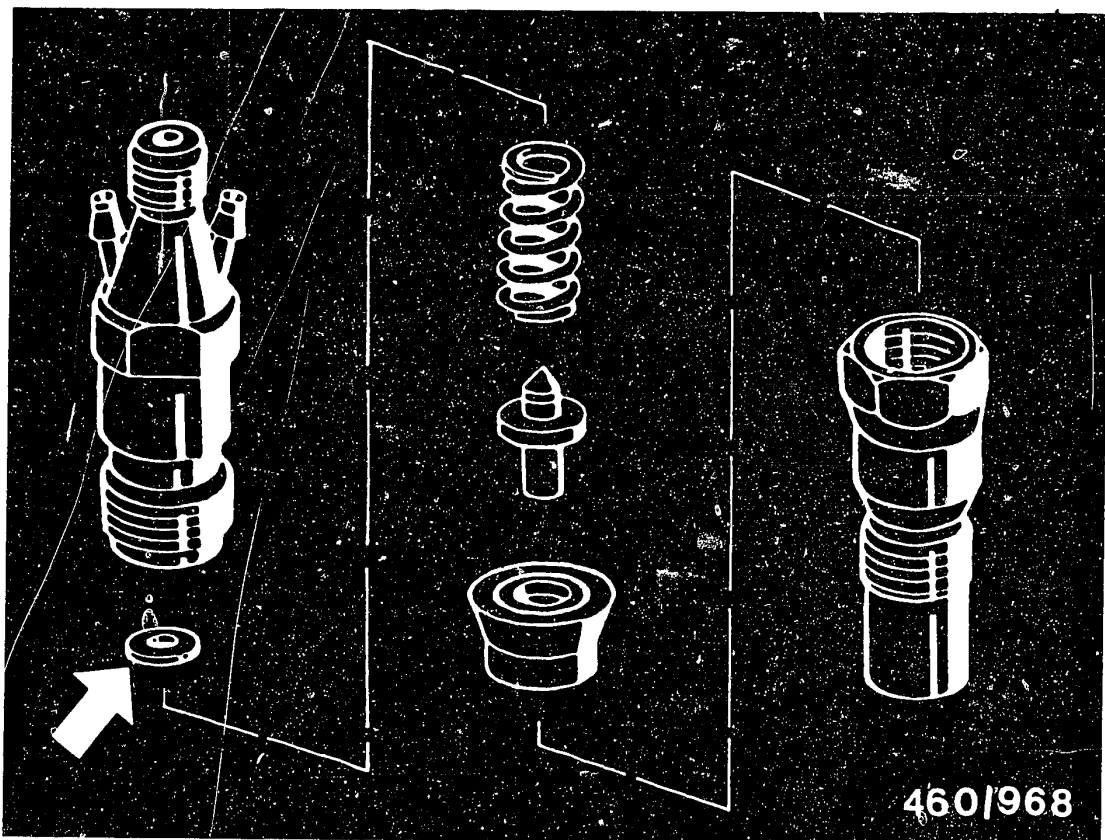
Slowly press down the manual lever on the nozzle tester (increased pressure on the pressure gauge).

Watch at which pressure the pointer of the pressure gauge stays (nozzle not chattering) or at which the pressure suddenly drops (nozzle chattering).

The maximum pressure attained in so doing is the opening pressure.







If there is a deviation from the specified value, correct the nozzle opening pressure by means of compensating washers behind the pressure spring (arrow).

**Specification:**

Opening pressure (new nozzles):	150 + 8 bar
Opening pressure (used nozzles) min.:	135 bar
Pressure difference	max. 15 bar

Specified value: Opening pressure, new	150 + 8 bar
Opening pressure, broken-in, min.	135 bar
Difference in pressure	max. 15 bar

thicker washers = higher nozzle opening pressure  
 thinner washers = lower nozzle opening pressure

Changing the spring travel by +/- 0.05 mm changes the nozzle opening pressure by approx. 5.0 bar.



### 27.3 Checking for leaks

Open the shutoff valve on the pressure gauge by approx. 1/4 turn.

Dry off the lower portion of the nozzle and nozzle-holder assembly. (Blow it dry with air.)

Slowly press down on the hand lever until the pressure gauge indicates 20 bar less than the opening pressure as read above. The nozzle does not leak if there is no drop dripping from the nozzle opening within 10 seconds.

If a drop drips off, take the nozzle-holder assembly combination apart and clean it.

If the leak is still there, take out and replace the nozzle.

It is not permissible to remachine the parts of the nozzle.

#### Note:

Striation on the holder assembly and the intermediate disc can be machined off provided the necessary care is taken (other than during the warranty period).



## 27.4 Chatter test - Evaluation of the spray pattern

### General information:

When evaluating nozzles, make a distinction between new and used nozzles.

Switch the pressure gauge off.

### New nozzles:

The chatter test makes it possible to test for ease of movement for the nozzle needle in the nozzle body by means of listening. If the nozzle does not chatter in spite of cleaning, it is to be replaced with a new nozzle. In the chatter test, the shape of the spray is of no significance. A spray pattern corresponding to specifications is generally present only with new nozzles.

### Used nozzles:

The chatter behavior of the nozzle deteriorates due to wear in the area of the seat. When the lever is moved quickly, the nozzle must chatter audibly and/or spray a well-atomized spray.

In the case of used nozzles, the spray pattern can deviate from the ideal shape from a new nozzle. The spray pattern from such nozzles however can be perceptibly improved by appropriate cleaning.



## 27.5 Chatter and spray test

Flat-type pintle nozzles with throttling effect are installed in the BMW 524 td (US).

These nozzles have a lateral flat on the pintle. This results in an oval spray pattern.

### Chatter test:

Due to its special construction, this nozzle chatters very softly. A chatter test is possible on it only when the hand lever is being moved between 1 and 2 downward movements per second. When testing speed is increased, the chattering stops. The calibrating oil then comes out of the nozzle with a hissing sound.

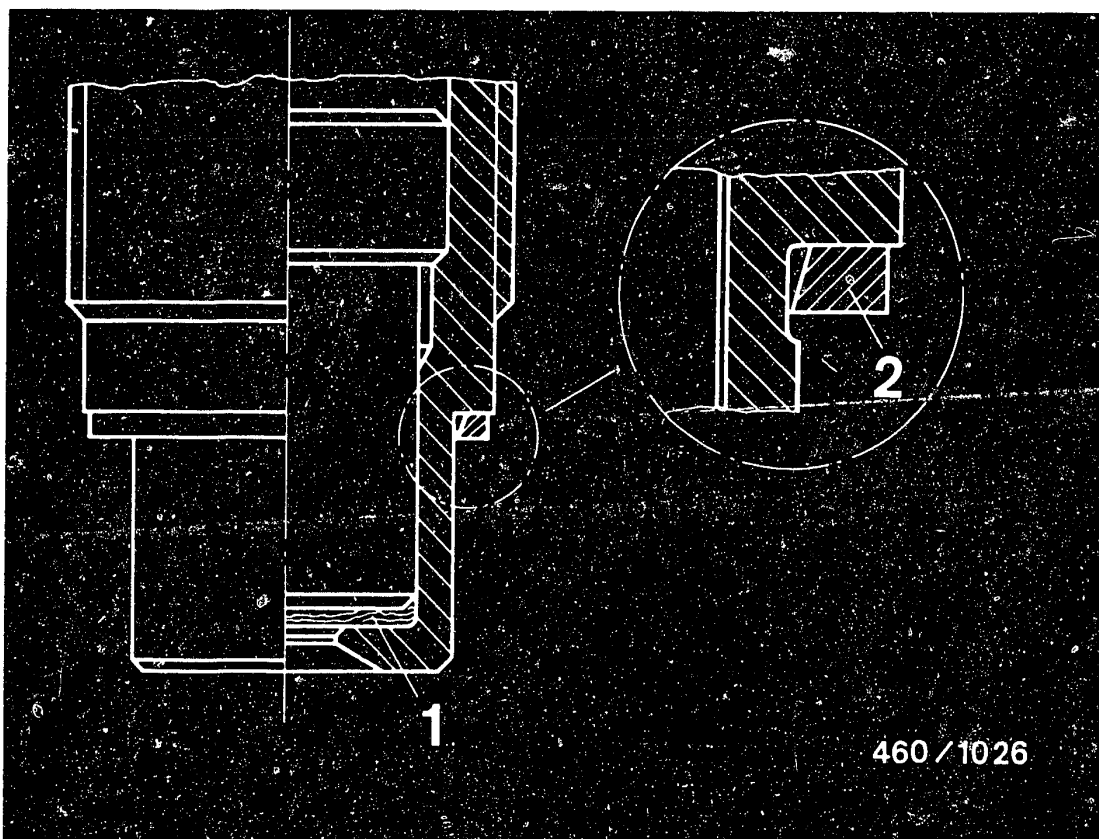
The nozzle chatters with a high-pitched whistling tone only when the hand lever is moved with fast jerks (approx. 4...6 downward movements per second).

### Spray pattern: (valid only for new nozzles)

Until the high whistling sound is attained, the spray can come out in strands and without atomization. A divided spray or streaming are of no significance in this range.

To assess the spray pattern, the hand lever is pressed down with sudden jerks (4...6 downward movements per second). The spray must then be well atomized. The cross section of the spray has an oval shape and is larger than the spray from a throttling pintle nozzle without a flat on the pintle.





- 1 = Thermal protection ring  
2 = Seal ring

#### 26.6 Put in the nozzle-holder assembly

On this type of engine, a nozzle-holder assembly with an integrated thermal protector (1) is installed.

The thermal protection ring is located between the base of the nozzle and the nozzle retaining nut (also designed as a thermal protection).

Every time the nozzle-holder assembly is taken apart (adjustment of opening pressure or replacement of nozzles), take out and replace the thermal protection ring.

The seal ring (2) is permanently mounted in the recess of the nozzle nut and must be taken out and replaced every time the nozzle-holder assembly is removed.

The press-in sleeve KDEP 1562 is used to press the seal ring on.

Installation instructions:

Put the arched side of the seal ring on facing the nozzle retaining nut.

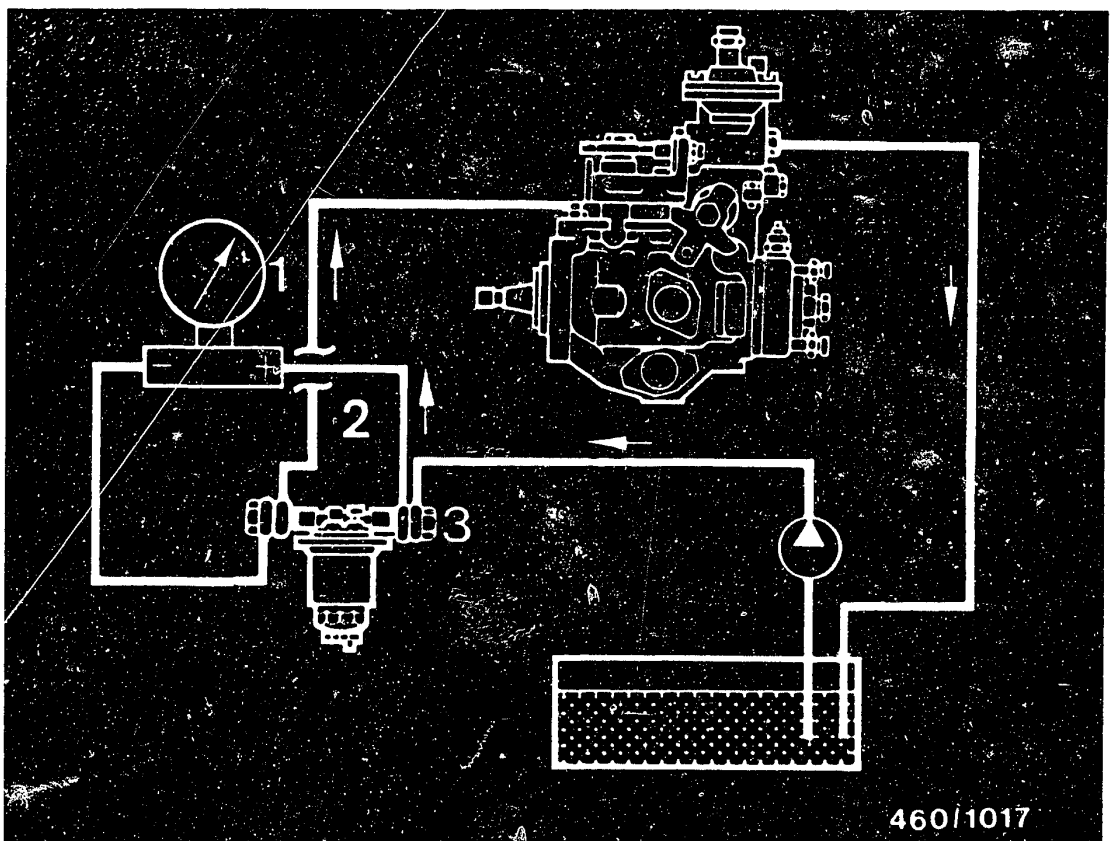
Screw the nozzle-holder assembly into the cylinder head and tighten to 40 ... 45 Nm.

Note:

If the tightening torque is exceeded, the nozzle needle can jam.

Tighten the union nuts for the injection lines to 20 ... 25 Nm.





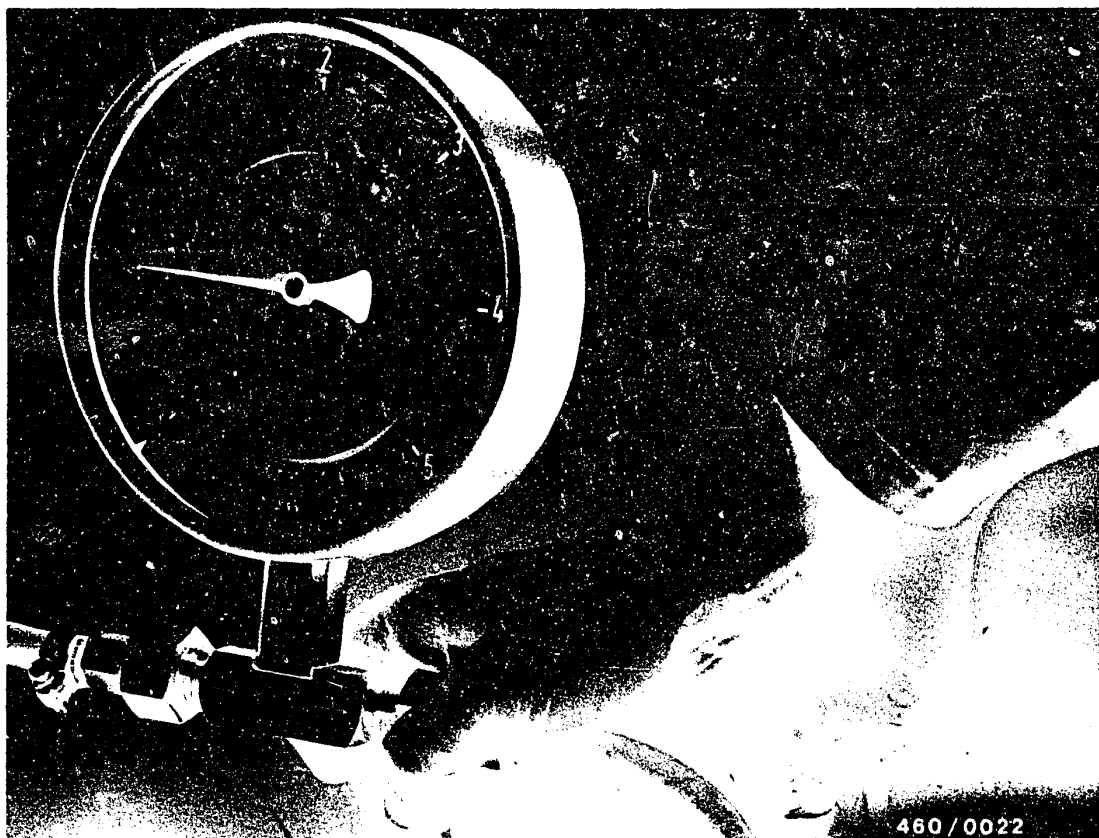
460/1017

- 1 = Differential pressure gauge
- 2 = Filter outlet  
(Use inlet union and overlong inlet-union screw  
2 443 456 020.)
- 3 = Filter inlet  
(Use inlet union and overlong inlet-union screw  
2 443 456 020.)

## 28. Connection diagram for filter test (differential pressure test)

Connect the differential pressure gauge to the fuel filter using appropriate connectors.



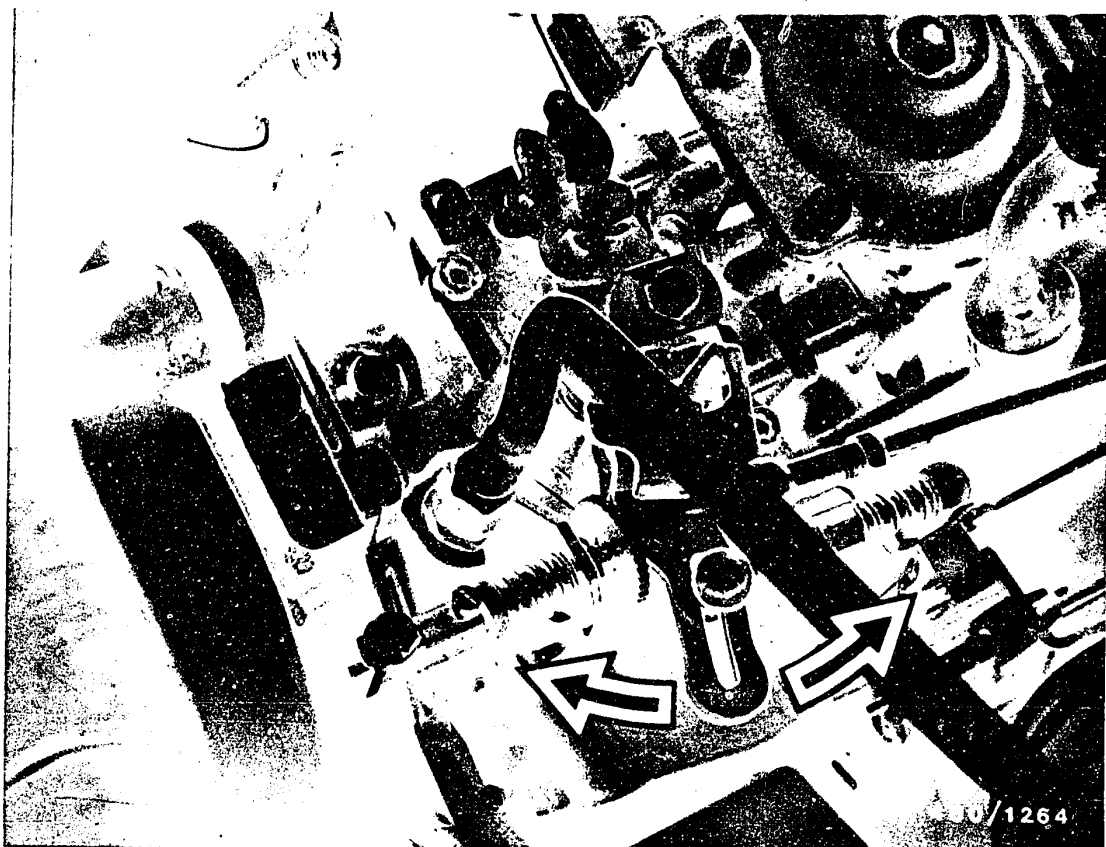


Connect the (+) side of the differential-pressure gauge to the fuel filter inlet. Fit the (-) connection of the pressure gauge to the filter outlet. See connection diagram.

Run engine until you are sure that there is no air in the fuel system.





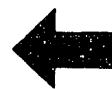


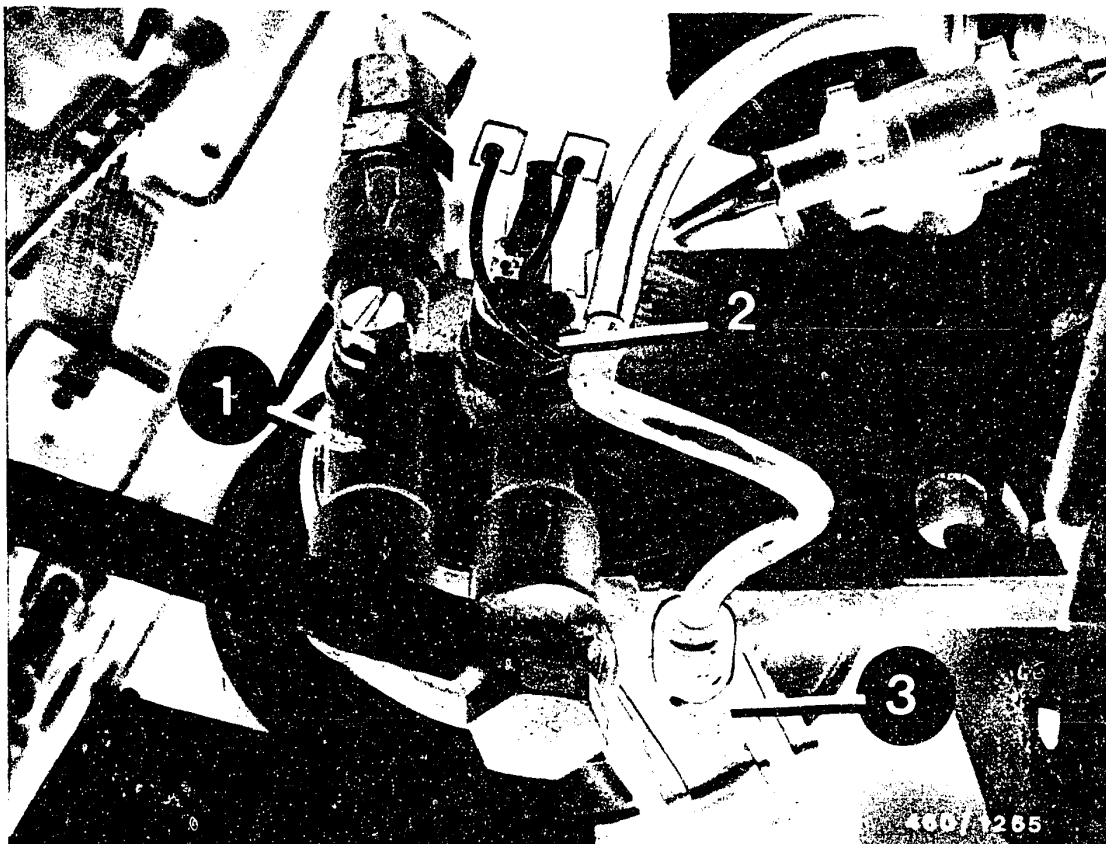
Move control lever of fuel-injection pump briskly (approx. 1 second) from idle stop to maximum-speed stop.

Release control lever and read off differential-pressure on pressure gauge.

The maximum permissible differential pressure is 0.3 bar. If this value is exceeded, replace filter. Remove test connections.

If necessary, bleed fuel system.





1 = Heating element    2 = Thermo-switch    3 = Heating element connection

### 29. FUEL PREHEATING

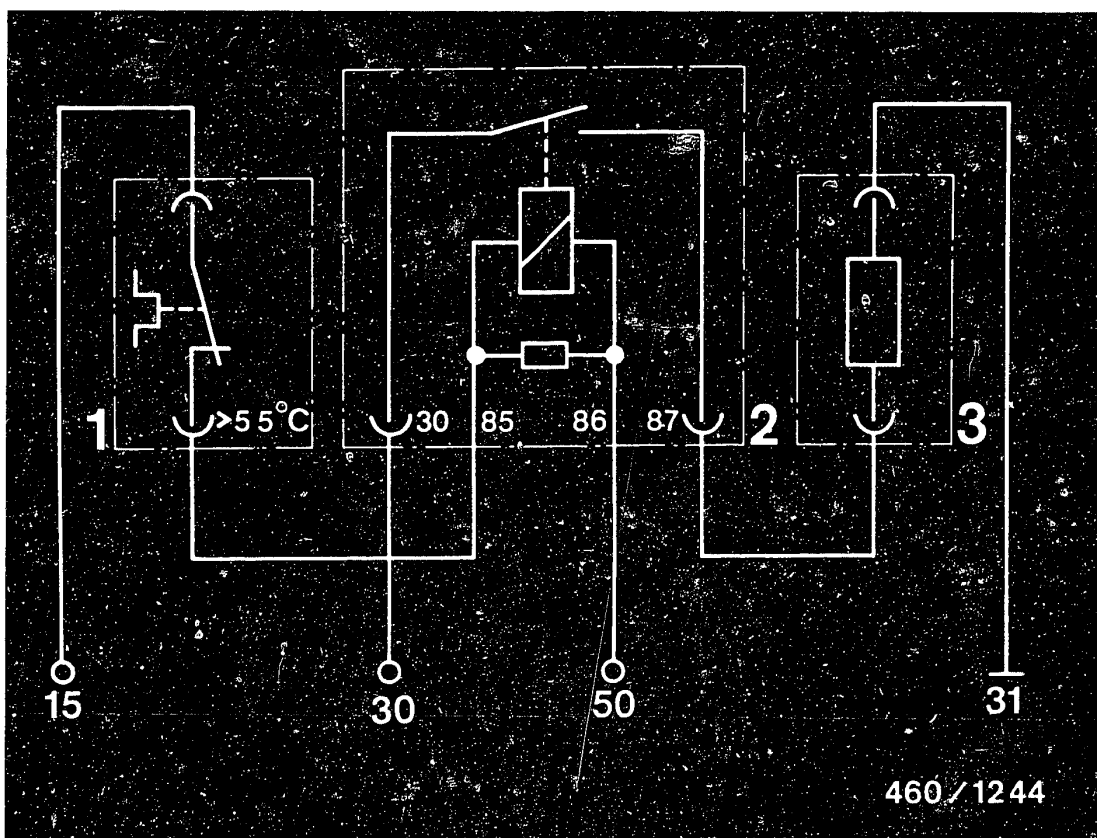
A heating element (1) is installed in the cover of the fuel filter to preheat the fuel.

At fuel temperatures below 5.5°C, the fuel is automatically preheated through a thermo-switch (2) which is installed in the filter cover.

#### Note:

The fuel preheating system is switched off during starting.





30. TESTING OF CLOSED-LOOP START-OF-INJECTION CONTROL  
WITH UNIVERSAL TEST ADAPTER ETT 018.01 - 0 684 101 801  
commercially available multimeter and test lead  
1 684 463 163.

Notes on the following trouble-shooting program

Using the universal test adapter and other suitable test equipment, the following trouble-shooting chart is intended to enable the workshop employees to quickly detect causes of trouble.

The program is divided into three rows of boxes:

The boxes in the left-hand row represent the most favorable sequence of the test steps. At the same time, each box contains all the necessary information on how to use the universal test adapter and measuring instrument, test conditions, test procedure and test specifications.

The center row contains the necessary instructions on each test step for finding and remedying the fault.

The right-hand row provides supplementary information - if necessary - by means of illustrations/sketches.

The sequence of the test steps represents the most favorable procedure. Always perform the entire program since the individual test steps build on each other. Branching to the center row of boxes is only necessary if, in a test step, the test specifications or functional requirements are not met.

**E1**

Test with universal test adapter  
BMW 524 td



### 30.1 Connection of universal test adapter:

The individual test steps are selected by means of two program switches (one for voltage measurements, the other for resistance measurements). Each program switch has 24 test settings, only some of which, however, are used for the closed-loop start-of-injection control system.

If, during a test, a fault is found, the test must be repeated after the fault has been remedied.

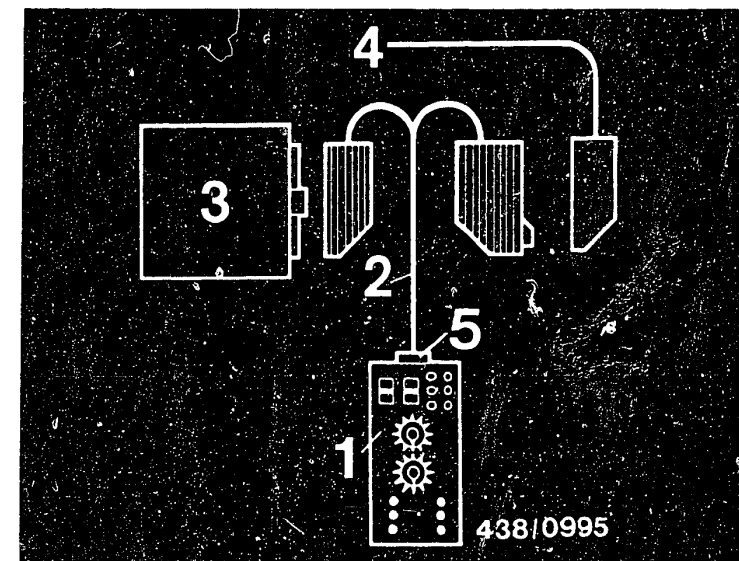
- Before testing with the universal test adapter, check all multiple plug-in connections for loose contacts.  
Clean contacts if dirty or corroded.
- Watch for receptacles that have been pushed back.  
If necessary, bend back the locking tab and press the receptacle as far as it will go into the plug housing; locking tab latches.
- Suspicion of line breaks in case of kinking and pinching.

Disconnect multiple plug from control unit (push back detent and first of all hinge up plug on side of detent). Connect plug to terminal strip of test lead of universal test adapter.

The multiple plug of the test lead is intended for connection to the control unit. However, it may only be connected for certain tests in the following test chart. Follow the corresponding instructions in each test step.

Important: Make sure that the ignition is off whenever connecting or disconnecting a plug on the control unit.

Connect multimeter (e.g. Mislco Master 50 K) in accordance with manufacturer's instructions to the appropriate test sockets of the universal test adapter (V,  $\Omega$ , 1-2 for current measurements).



- 1 = Universal test adapter
- 2 = System adapter lead
- 3 = Control unit
- 4 = System wiring harness
- 5 = Pin terminal

**E2**

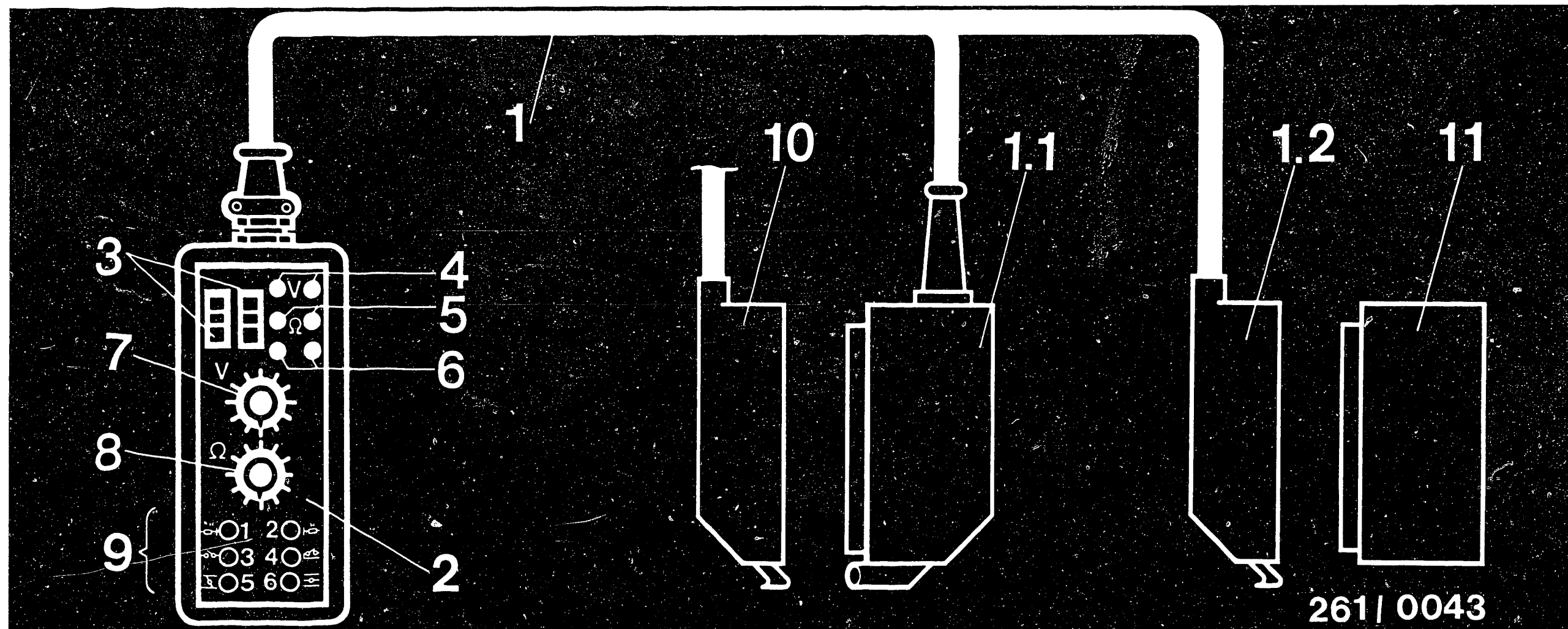
Test with universal test adapter  
BMW 524 td



**E3**

Test with universal test adapter  
BMW 524 td





### 30.2 Construction and application of universal test adapter:

- 1 = Closed-loop start-of-injection control test lead 1 684 463 163
- 1.1 = Connection to wiring harness
- 1.2 = Connection to control unit
- 2 = Universal test adapter ETT 018.01 - 0 684 101 801
- 3 = Test wells for motortester (not used)
- 4 = Test sockets for voltage measurements
- 5 = Test sockets for resistance measurements
- 6 = Test sockets for current measurements
- 7 = Program switch "V"
- 8 = Program switch "Ω"

- 9 = Button panel for simulation of operating conditions
  - Button 1 = Simulation of engine "cold" (-20°C)
  - Button 2 = Simulation of engine "warm" (approx. +80°C)
  - Button 3 = Triggering of diagnosis indicator lamp
  - Button 4 =
  - Button 5 = not occupied
  - Button 6 =
- 10 = Control-unit plug (vehicle wiring harness)
- 11 = Control unit

**E4**

Test with universal test adapter  
BMW 524 td



**E5**

Test with universal test adapter  
BMW 524 td



### 30.3 Test instructions:

To facilitate the detection of faults, the control unit is equipped with a self-diagnosis feature:

1. In the event of malfunctions in the closed-loop start-of-injection control, the "injection" warning lamp (in the check unit above the windshield) lights up continuously.
2. Through activation of the self-diagnosis feature in the control unit, a pulse is output, depending on the cause of the fault, in conjunction with the universal test adapter and test lead, and is indicated by the injection indicator lamp.  
The self-diagnosis can also be evaluated with the aid of a voltmeter (analog) by its deflection, or by a bulb by its lighting up. To activate the self-diagnosis, connect control unit, press button 3 of universal test adapter for 1...2 sec and run the engine at idle speed.
3. If a fault is found during the test, after it has been remedied, trigger the self-diagnosis again in order to check and in order to identify a further fault.



Malfunction	Indication
Needle-movement sensor	2 pulses
Engine-speed sensor	4 pulses
Timing valve	6 pulses
Temperature sensor	8 pulses

Note:

To evaluate the flashing code, connect voltmeter or bulb to the  $\Omega$  sockets of the test adapter.

If looking for a fault in the diesel fuel-injection system as a result of a customer complaint, trigger the self-diagnosis of the control unit.

If no flashing code is output, then there is no fault in the closed-loop start-of-injection control.





### 30.4 Test closed-loop start-of-injection control

#### TEST STEP 1

##### Power supply to control unit

Switch off ignition. Disconnect plug from control unit.

##### Switch settings

V	$\Omega$	Button
8	-	-

Switch on ignition.

Test specification:

8...15 V

Test specification obtained?

no

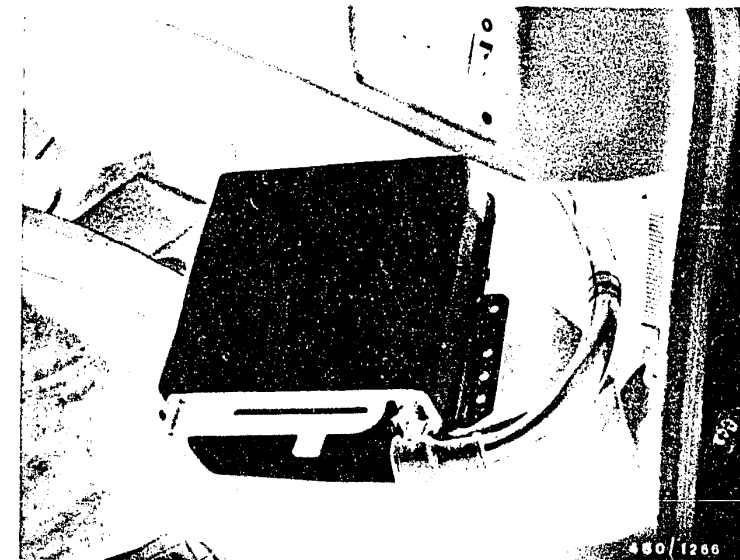
Check operation and energization of incorrect-polarity protection relay.  
(30 → term. 87, 15 to term. 86, ground → term. 85).

If O.K., check for open circuit in lead between term. 87 of incorrect-polarity protection relay and pin 35 of control-unit plug.

Eliminate open circuit.

yes

Continued on E10/E11



Installation position of control unit:  
in glove compartment under a cover

**E8**

Test with universal test adapter  
BMW 524 td



**E9**

Test with universal test adapter  
BMW 524 td




## TEST STEP 2

### Test of injection indicator lamp in vehicle

Control-unit plug disconnected from control unit.

#### Switch settings

V	$\Omega$	Button
	19	3

Switch on ignition.  
Indicator lamp lit?

no

1. Check bulb for open circuit.  
Replace bulb.
2. Check for open circuit in lead between pin 12 of control-unit plug and term. 12 of injection indicator lamp.  
Eliminate open circuit.
3. Check for open circuit in positive lead to indicator lamp.  
Eliminate open circuit.

yes

### Test of self-diagnosis of control unit


#### Note:

To test, a failure of the engine-speed sensor is simulated.

Indication: 4 pulses

To evaluate the flashing code, connect multimeter (switch setting V) to  $\Omega$  sockets of universal test adapter.  
Switch off ignition.  
Connect control-unit plug to control unit.

#### Switch settings

V	$\Omega$	Button
	19	3

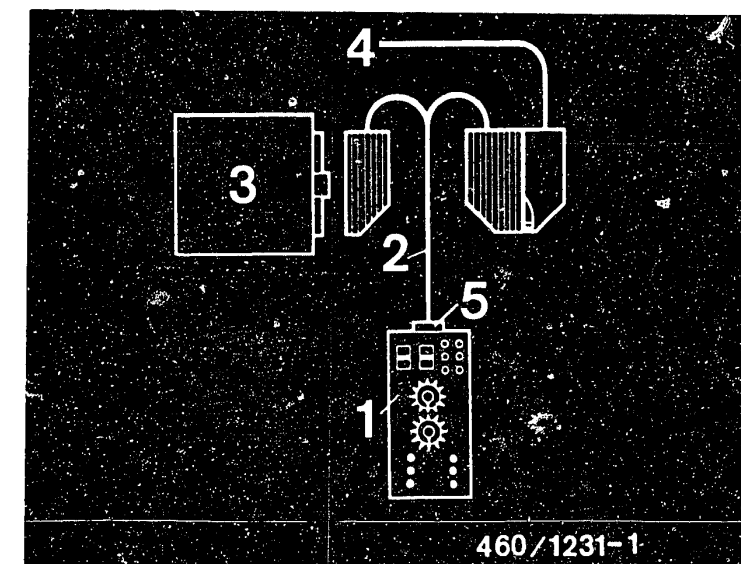
Switch on ignition.  
Pulses indicated?

no

No pulse sequence or pulse sequence incorrect:  
Control unit defective, replace.

yes

Continued on E12/E13



460/1231-1

- 1 = Universal test adapter
- 2 = System adapter lead
- 3 = Control unit
- 4 = System wiring harness
- 5 = Pin terminal

**E10**

Test with universal test adapter  
BMW 524 td



**E11**

Test with universal test adapter  
BMW 524 td



### TEST STEP 3

Test of closed-loop start-of-injection control  
(triggering of diagnosis indication)

Control-unit plug connected to control unit.

Switch settings

V	$\Omega$	Button
↓	19	3

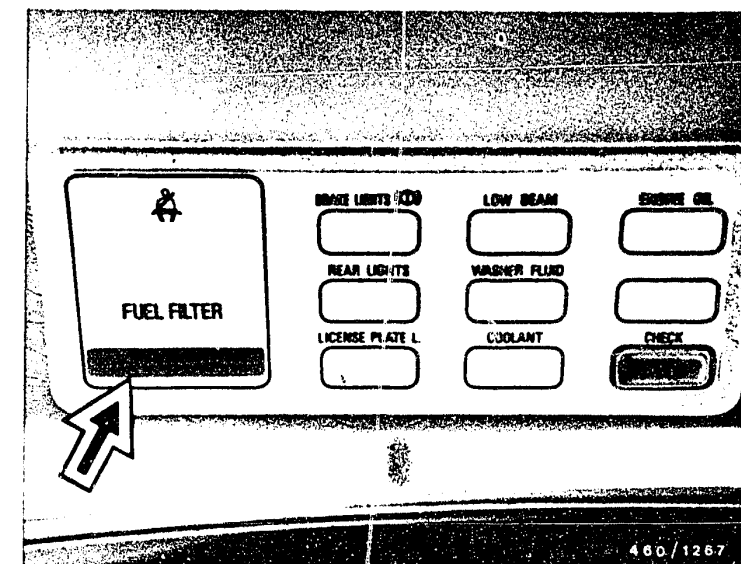
Switch on ignition.  
Start engine.

No fault indication  
(closed-loop start-of-injection control O.K.)?  
Continue testing with test step 8.

no

If closed-loop start-of-injection control not O.K., continue testing in accordance with the fault indicated:

- 2 pulses = Needle-movement sensor defective
- 4 pulses = Engine-speed sensor defective
- 6 pulses = Timing valve defective
- 8 pulses = Temperature sensor defective.



Arrow=Diagnosis indicator lamp

yes

Continued on F1/F2

Continued on E14/E15

**E12**

Test with universal test adapter  
BMW 524 td

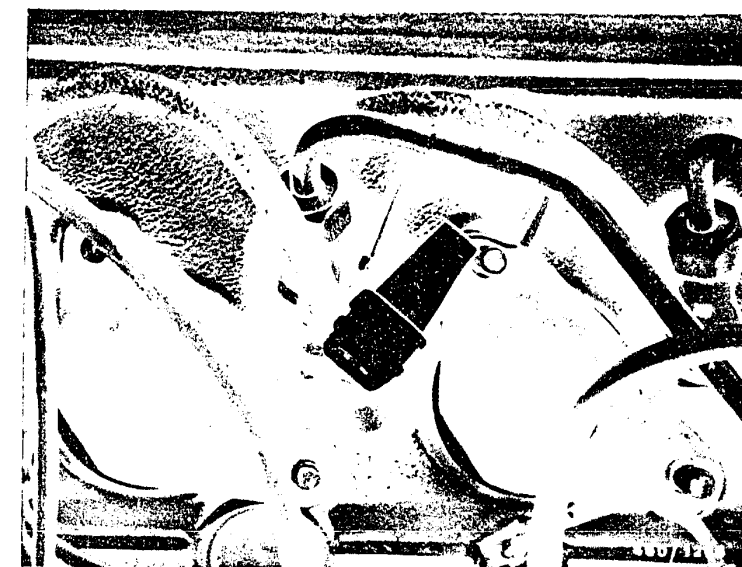
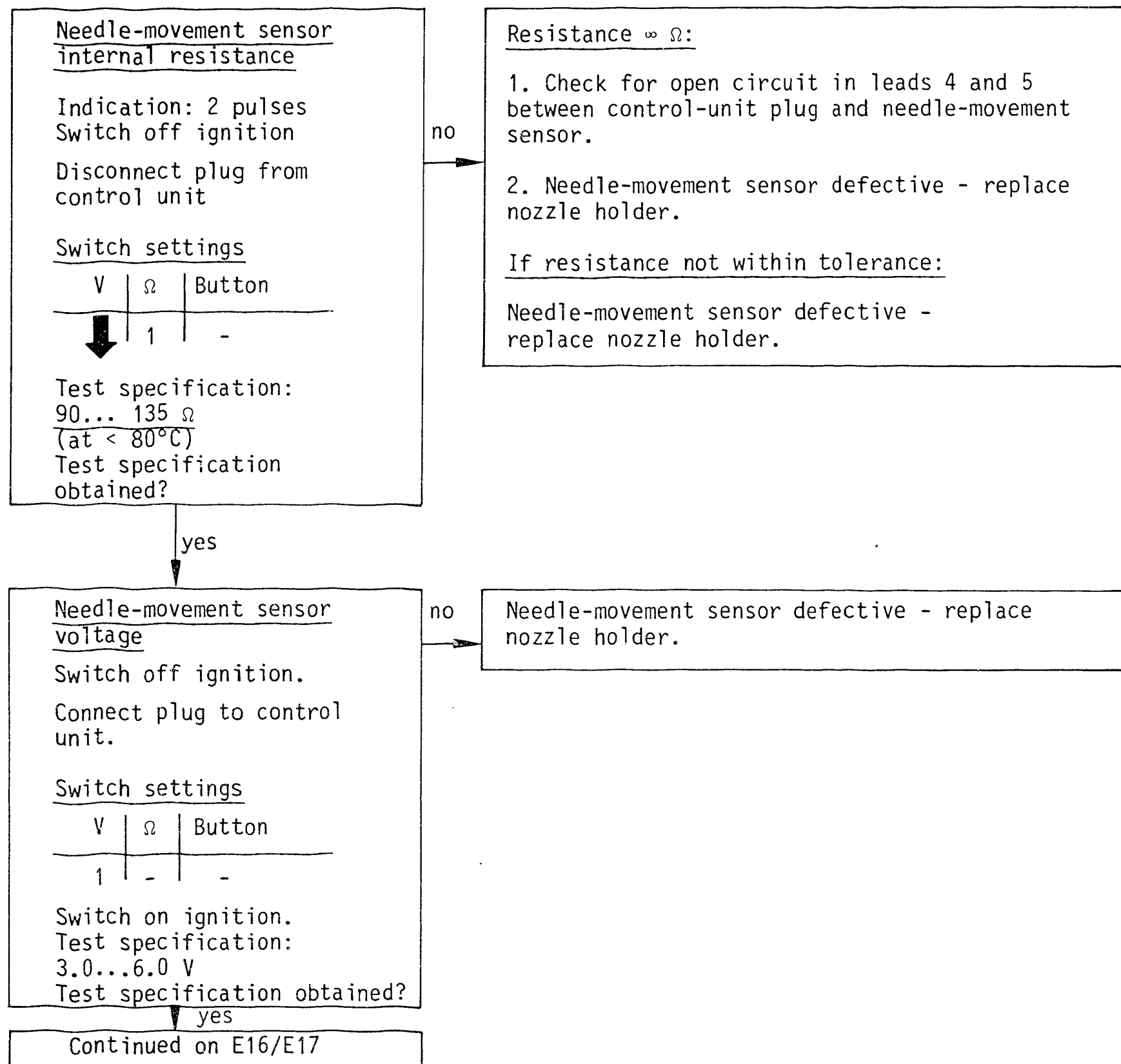


**E13**

Test with universal test adapter  
BMW 524 td



# TEST STEP 4



Nozzle holder with needle-movement sensor (cylinder 4)

**E14**

Test with universal test adapter  
BMW 524 td



**E15**

Test with universal test adapter  
BMW 524 td



## TEST STEP 5

### Engine-speed sensor internal resistance

Indication: 4 pulses  
Switch off ignition.

Disconnect plug from control unit.

### Switch settings:

V	$\Omega$	Button
↓	6	-

Test specification:  
860...1060  $\Omega$

Test specification  
obtained?

no

### Resistance $\infty \Omega$ :

1. Check for open circuit in leads 8 and 27  
between control-unit plug and engine-speed  
sensor.

2. Engine-speed sensor defective - replace.

### Test for short circuit to ground:

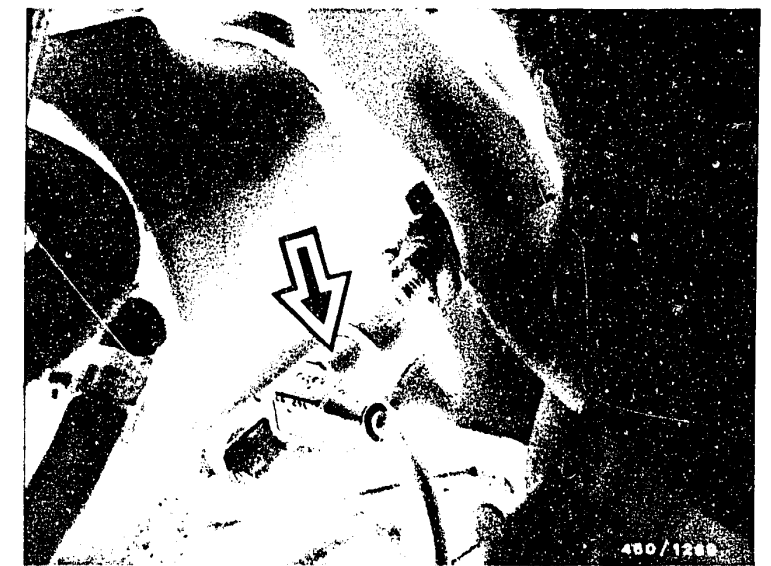
Resistance between engine-speed sensor lead  
8 and ground < 100 k $\Omega$ , replace engine-speed  
sensor.

### If resistance not within tolerance:

Engine-speed sensor defective, replace.

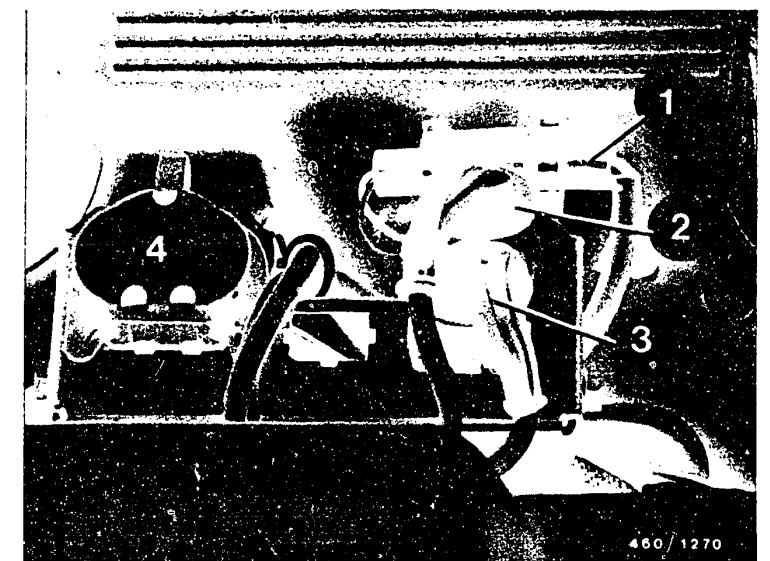
yes

Continued on E 18/E 19



Installation position of engine-speed  
sensor (arrow)

Plug connections (charge-air pipe)  
1=Timing valve  
2=Needle-movement sensor  
3=Engine-speed sensor  
4=Diagnostic plug



**E16**

Test with universal test adapter  
BMW 524 td



**E17**

Test with universal test adapter  
BMW 524 td



## TEST STEP 6

### 6.1 Timing valve internal resistance

Control-unit plug disconnected from control unit.

Indication: 6 pulses

#### Switch settings

V	$\Omega$	Button
↓	9	-

Test specification:  
15...22  $\Omega$

Test specification  
obtained?

no

#### Resistance $\infty \Omega$ :

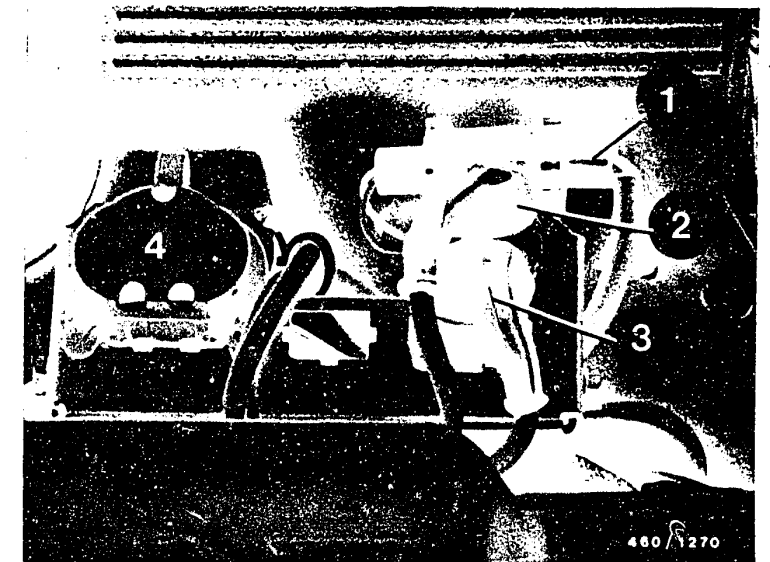
1. Check for open circuit in leads 14 and 18 between control-unit plug and timing valve (distributor-type fuel-injection pump).
2. Timing valve defective - replace (remove distributor-type fuel-injection pump).

#### If resistance not within tolerance:

Timing valve defective - replace.

yes

Continued on E20/E21



Plug-in connections (charge-air pipe)

1=Timing valve

2=Needle-movement sensor

3=Engine-speed sensor

4=Diagnostic plug

**E18**

Test with universal test adapter  
BMW 524 td



**E19**

Test with universal test adapter  
BMW 524 td



## TEST STEP 6 (continued)

### 6.2 Timing valve signal (engine warm) (coolant temperature $+80^{\circ}\text{C}$ )

Switch off ignition.

Connect control-unit plug to control unit.

#### Switch settings:

V	$\Omega$	Button
-	-	2

Disconnect needle-movement sensor.

Connect pocket tester to test sockets 1 and 2 of test adapter.

(Dwell angle measuring range).

Switch on ignition and start engine.

Test specification: On/off ratio 28...

32 %

Test specification obtained?

no

Control unit defective - replace.

yes

### 6.3 Timing valve signal (engine cold)

Control-unit plug connected to control unit.

#### Switch settings:

V	$\Omega$	Button
-	-	1

Test conditions as for 6.2.

Disconnect needle-movement sensor.

Connect pocket tester to test sockets 1 and 2 of test adapter.

(Dwell angle measuring range).

Switch on ignition and start engine.

Test specification: On/off ratio 13...

17 %

Test specification obtained?

no

Control unit defective - replace.

yes

Continued on E22/E23

**E20**

Test with universal test adapter  
BMW 524 td



**E21**

Test with universal test adapter  
BMW 524 td



## TEST STEP 7

### Engine temperature sensor internal resistance

Indication: 8 pulses

Switch off ignition.

Disconnect control-unit plug from control unit.

### Switch settings

V	$\Omega$	Button
↓	5	-

Test specification:  
At engine temperature  
+15°C...+30°C:

1.3...3.6 k $\Omega$

At engine temperature  
approx. +80°C:

250...390  $\Omega$

Test specifications  
obtained?

yes

Continued on F1/F2

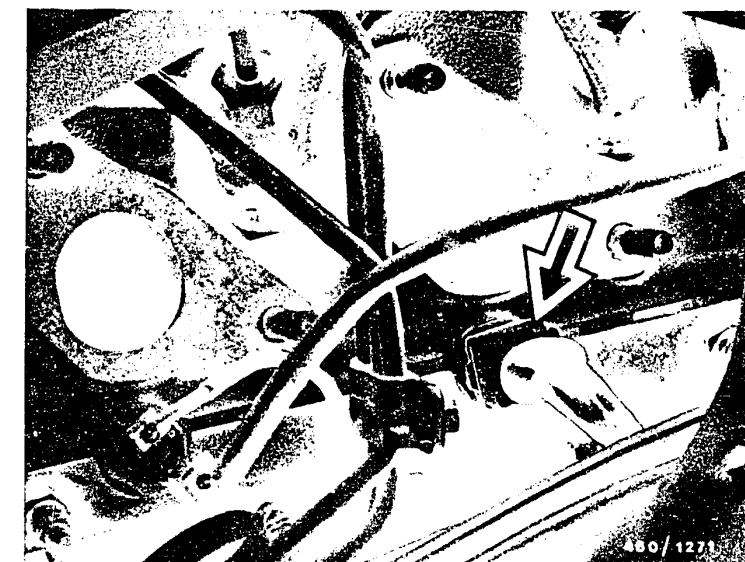
### Resistance $\infty \Omega$ :

1. Check for open circuit in leads 6 and 13  
between control-unit plug and coolant tempera-  
ture sensor.

Engine temperature sensor defective - replace.

### Resistance not obtained:

Engine temperature sensor defective - replace.



Arrow=Engine temperature sensor

**E22**

Test with universal test adapter  
BMW 524 td



**E23**

Test with universal test adapter  
BMW 524 td





## TEST STEP 8

Engine-speed output voltage  
(t<sub>D</sub> signal)

No pulse indication.  
Switch off ignition.  
Connect control-unit plug  
to control unit.

Switch settings:

V	Ω	Button
9	-	-

Run engine at idle speed.

Test specification:  
0.6...3.0 V

Test specification obtained?

no

Control unit defective - replace.

yes

Continued on F3/F4

**F1**

Test with universal test adapter  
BMW 524 td



**F2**

Test with universal test adapter  
BMW 524 td



# TEST STEP 8

Switching on/off of EGR valve

No pulse indication.

Control-unit plug connected to control unit.

Switch settings:

V	$\Omega$	Button
↓	4	-

Measure at  $\Omega$  sockets.  
Start engine and raise engine speed:

Test specification:

Switch-on point: 1000 min<sup>-1</sup>  
Switch-off point: 2800 min<sup>-1</sup>

Engine-speed points obtained?

no

1. Coolant temperature < 78°C.

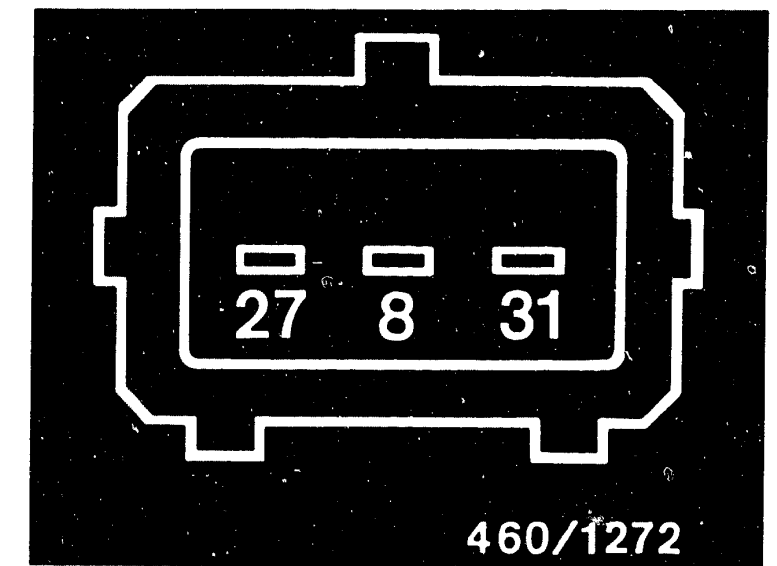
2. Adjust distance between pulse generator (engine-speed sensor) and a pin of the flywheel to  $1.35 \pm 0.05$  mm by moving the holding bracket.

3. Check the dynamic signal of the engine-speed sensor.  
Connect voltmeter to leads 27 and 8. Start engine. AC voltage at idle if pulse generator gap correct  $\geq 1.7$  V.

4. Control unit defective - replace.

yes

Testing completed.  
Closed-loop start-of-injection control O.K.



Engine-speed sensor plug

**F3**

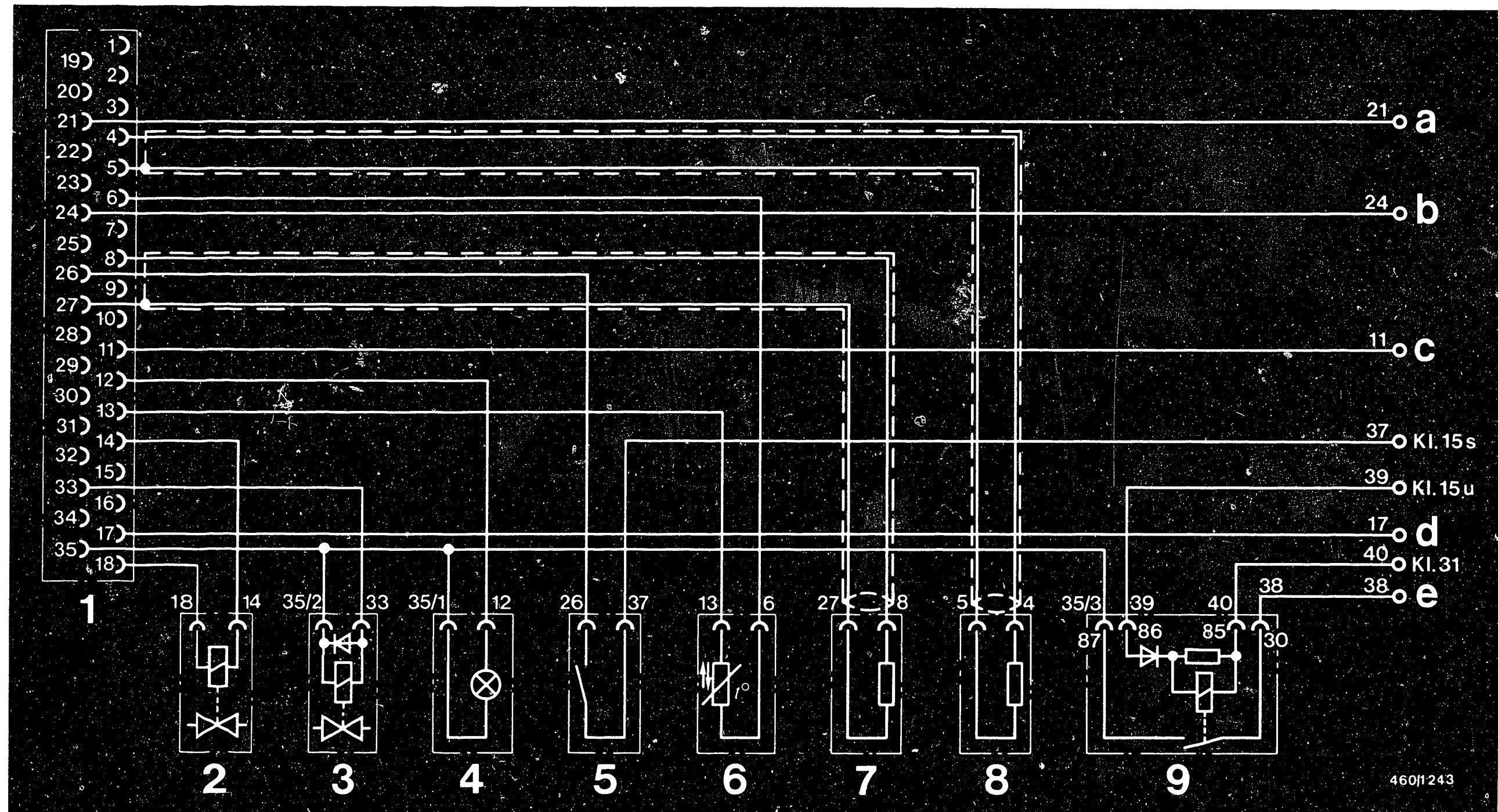
Test with universal test adapter  
BMW 524 td



**F4**

Test with universal test adapter  
BMW 524 td





4601243

**F5**

Test with universal test adapter  
 BMW 524 td



**F6**

Test with universal test adapter  
 BMW 524 td



### 31. CHECK PRE-HEATING SYSTEM

#### Necessary test equipment

Voltmeter/  
ammeter e.g. ETT 011.00 Part No. 0 684 101 100

#### Workshop information

We recommend that the "R"-type sheathed-element glow plugs be replaced every 45 000 km.

#### Note:

If the start of delivery is incorrectly adjusted, this may considerably shorten the service life of the sheathed-element glow plug.

#### Pre-heating time

The pre-heating time of the pre-heating system is dependent on the ambient temperature.

**F7**

Test preheating system  
BMW 524 td



## Test preheating system

### Test conditions:

- Battery O.K.?
- Compression O.K.? If necessary, test compression loss.
- Fuel supply and injection O.K.?

yes

### Test power supply to sheathed-element glow plugs.

Connect voltmeter to sheathed-element glow plugs, one after the other, and to ground. Set glow-plug and starting switch to position 1 (red repeater lamp lit). Pre-heating is started.

Voltmeter must indicate at least 10 V.

### Caution:

The system switches off automatically after at least 8...13 seconds. If the measurement has to be repeated, return the glow-plug and starting switch to position 1.

Minimum voltage present at all sheathed-element glow plugs?

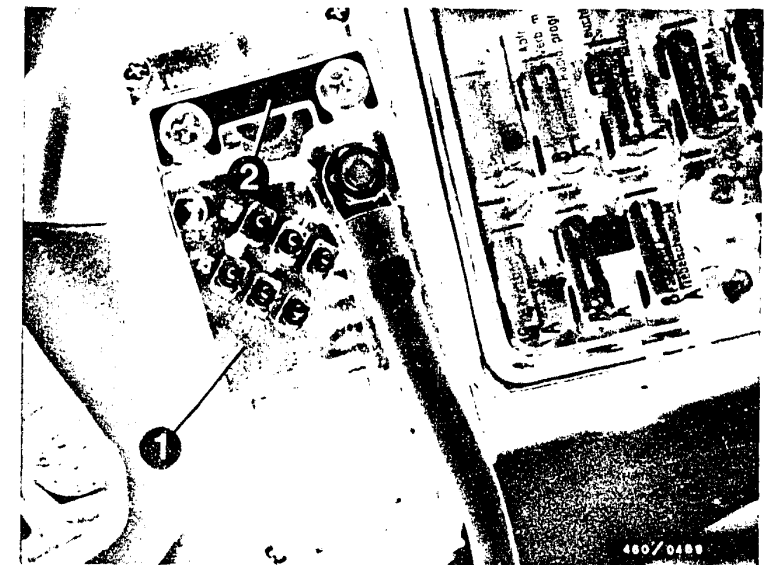
yes

Continued on F 10/F 11

No

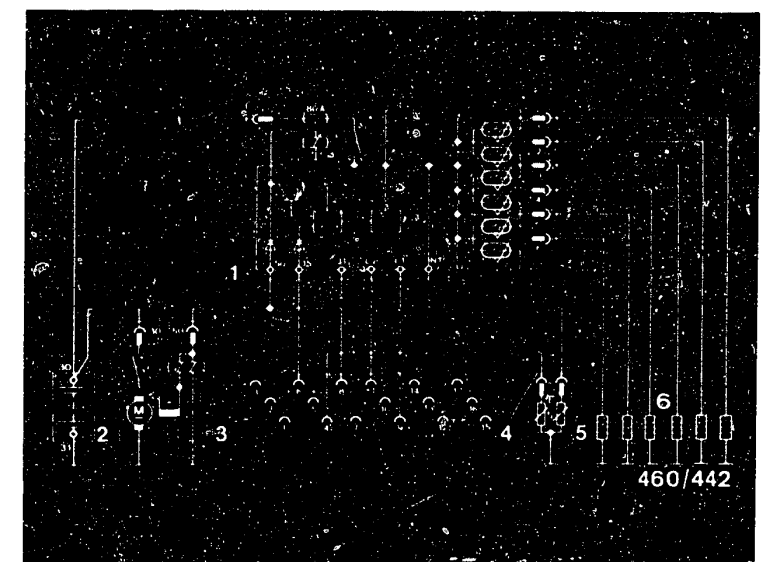
- Test for open circuit in leads from glow-duration unit term. 1...6 to the sheathed-element glow plugs. If necessary, eliminate open circuit.
- Test for open circuit in lead from battery (+) to glow-duration unit. If necessary, eliminate open circuit.
- Test for open circuit in ground lead of glow-duration unit term. 31. If necessary, eliminate open circuit.
- Remove protective cap from glow-duration unit and check strip fuse (80 A). Replace if necessary.

If points 1...4 O.K., then replace glow-duration unit.



1 = Glow-duration unit  
2 = Strip fuse (80 A)

Terminal diagram of preheating system



F8

Test preheating system  
BMW 524 td



F9

Test preheating system  
BMW 524 td



# Test preheating system (continued)

yes

## Test start repeater lamps (top picture)

Set glow-plug and starting  
switch to position 1.

Start repeater lamp L1 (red)  
must light up.

Shortly afterwards L1 (red)  
goes out and L2 (green)  
must light up.

Both start repeater lamps  
lighting up in the correct  
sequence?

no

## Green repeater lamp L2 not lighting up (center picture)

Test sheathed-element glow plugs (G)  
for open circuit.  
Replace defective sheathed-element  
glow plug(s).

## Neither repeater lamp lighting up (bottom picture)

1. Test for open circuit in leads from  
glow-duration unit to start repeater  
lamps L1 and L2 including the start  
repeater lamps, as well as their  
ground connection.

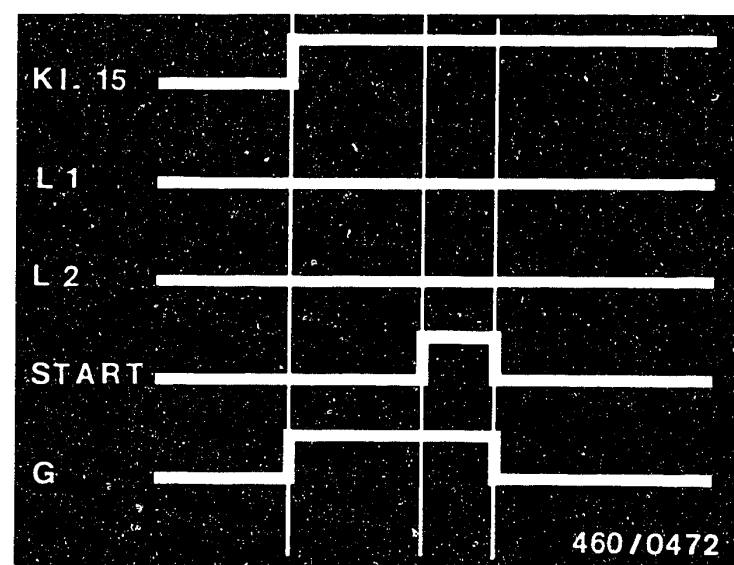
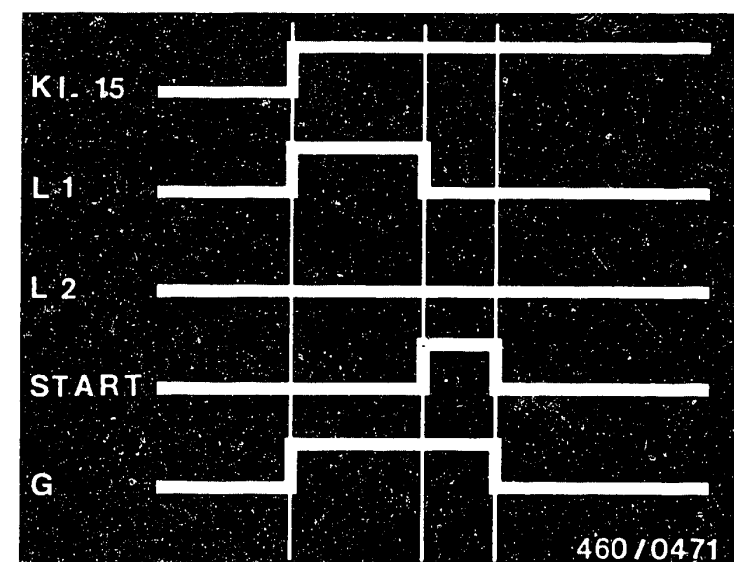
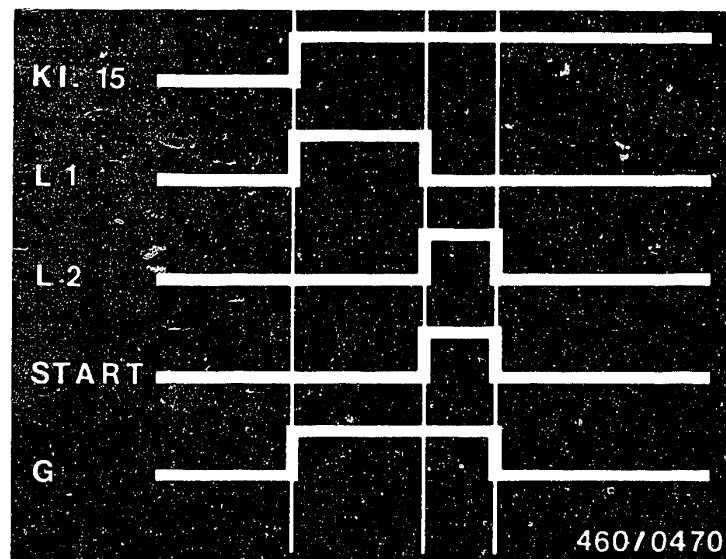
2. Remove protective cap from glow-  
duration unit and check strip fuse  
(80 A), replacing if necessary.

If Points 1 and 2 O.K., replace glow-  
duration unit.

yes

Continued on F 12/F 13

Continued on F 12/F 13



F10

Test preheating system

BMW 524 td



F11

Test preheating system

BMW 524 td



Test preheating system (continued)

yes

Red repeater lamp L1 flashing  
(top picture)

A flashing repeater lamp indicates that the sheathed-element glow plugs are continuing to glow after the engine has started. Remove plug from glow-duration unit and replace glow-duration unit.

Note:

If the red repeater lamp L1 does not light up, but, nevertheless, readiness for starting is indicated after pre-heating (green lamp L2), it is also possible that the red bulb is defective.

Test safety switch-off circuit

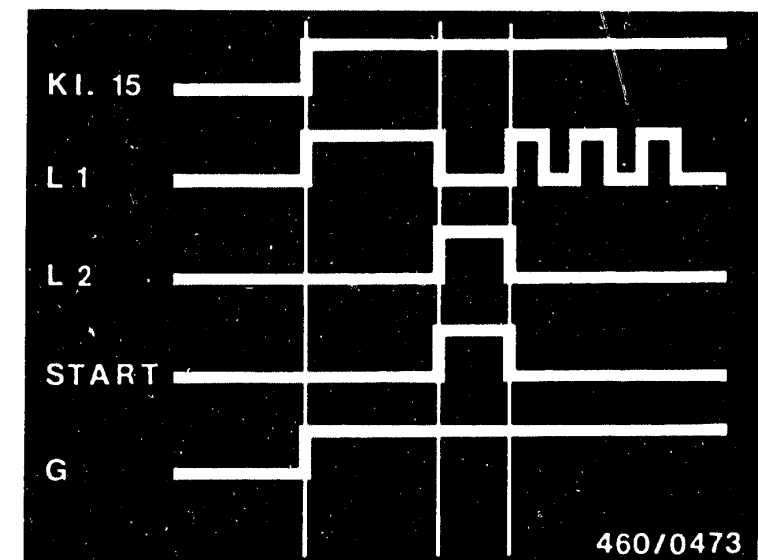
Connect voltmeter to one sheathed-element glow plug and to ground. Set glow-plug and starting switch to position "1" (red repeater lamp lights up). Pre-heating is started. After a certain pre-heating time, dependent on the ambient temperature, L2 (green) lights up. Voltmeter must indicate voltage for 13 seconds (bottom picture). After the specified period has elapsed, the voltmeter must indicate 0 V. Voltmeter at 0 V after specified period:

no

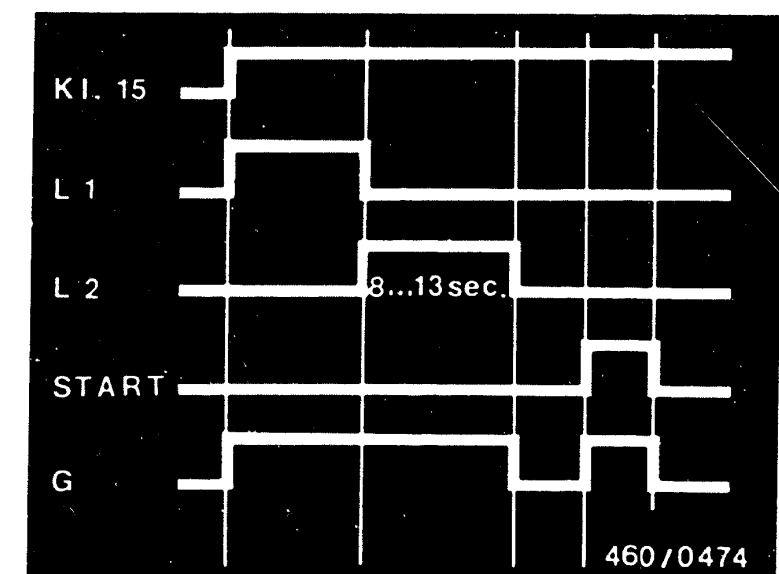
Replace glow-duration unit.

yes

Continued on F 14/F 15



460/0473



460/0474

F12

Test preheating system  
BMW 524 td

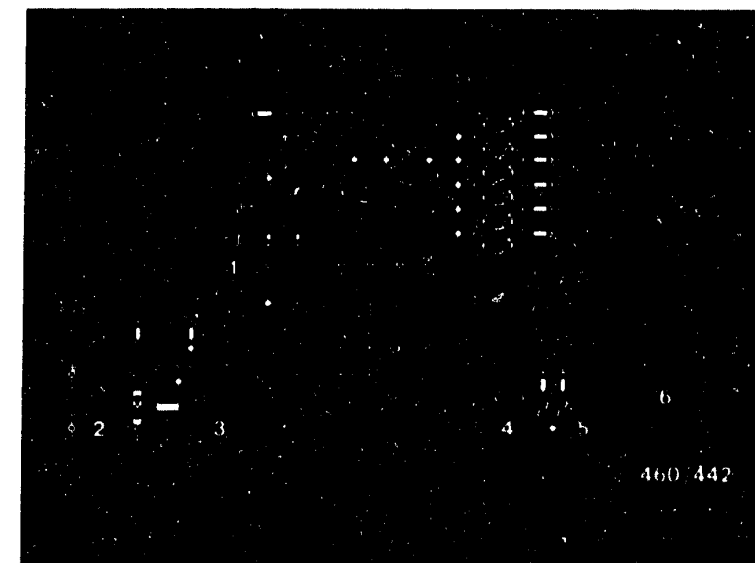
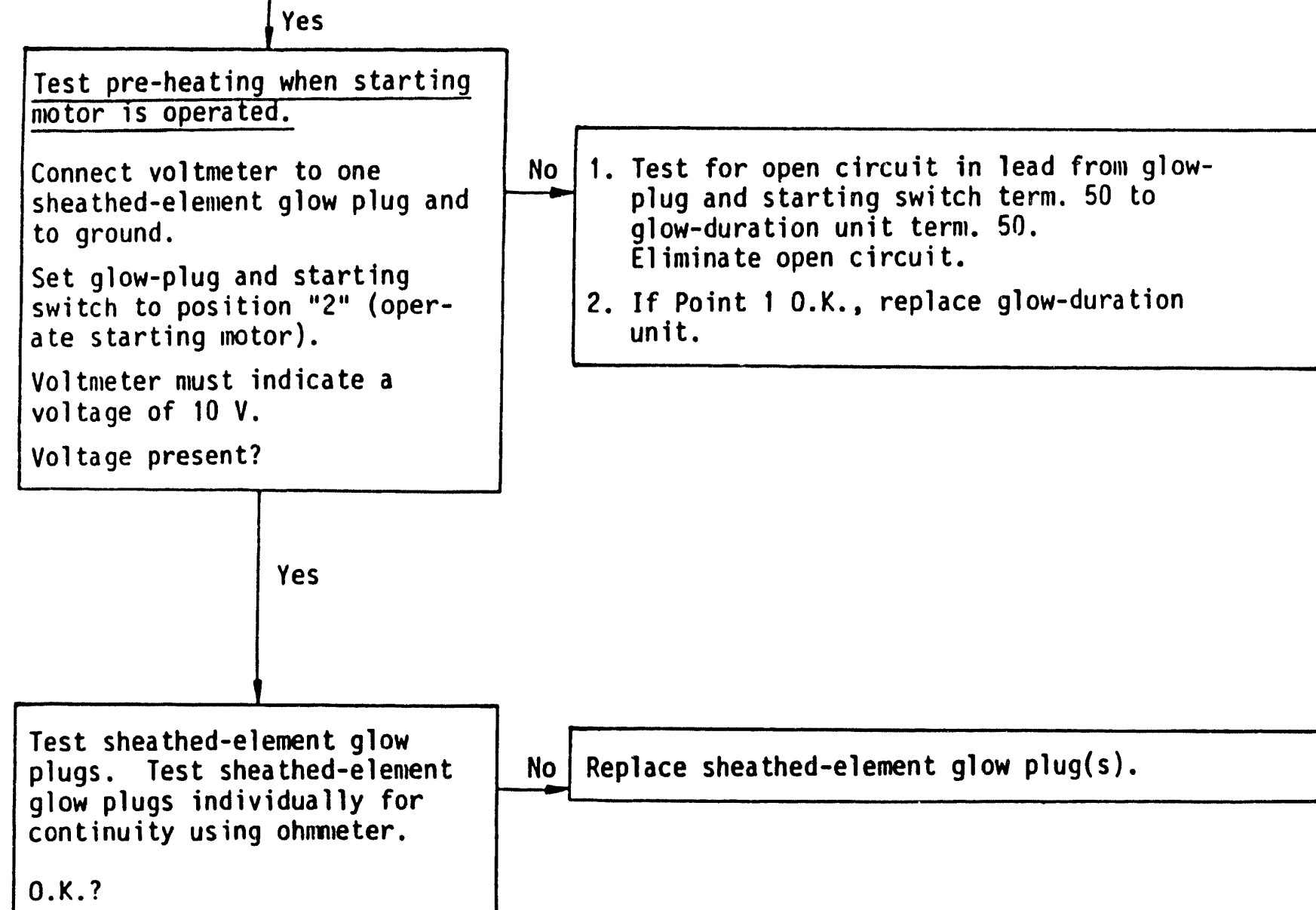


F13

Test preheating system  
BMW 524 td



# Test preheating system (continued)



Terminal diagram of preheating system

**F14**

Test preheating system

BMW 524 td



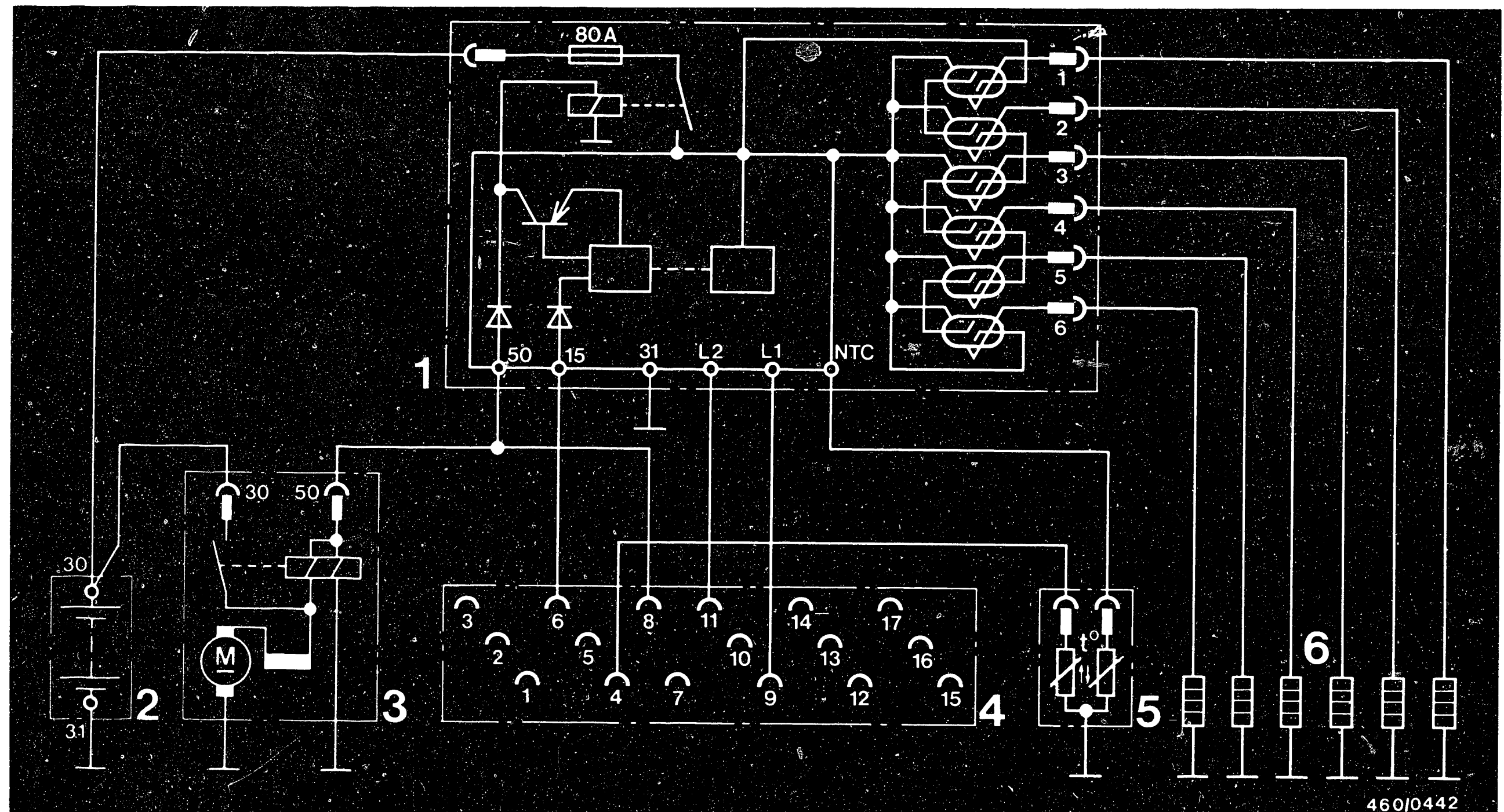
**F15**

Test preheating system

BMW 524 td







1 = Glow duration unit  
2 = Battery

3 = Starting motor  
4 = Diagnostic plug

5 = Temperatur sensor  
6 = Sheathed-element glow plugs

31.1 Terminal diagram of preheating system

**F16**

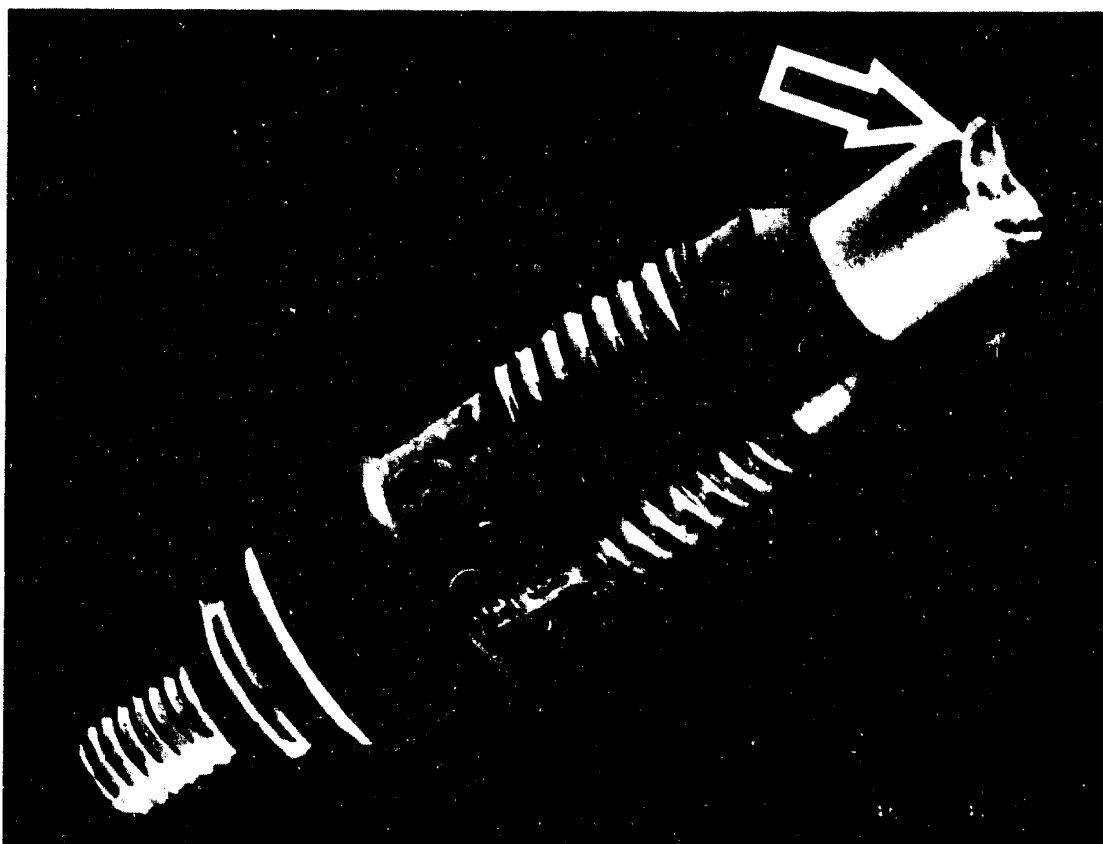
Test preheating system  
BMW 524 td



**F17**

Test preheating system  
BMW 524 td





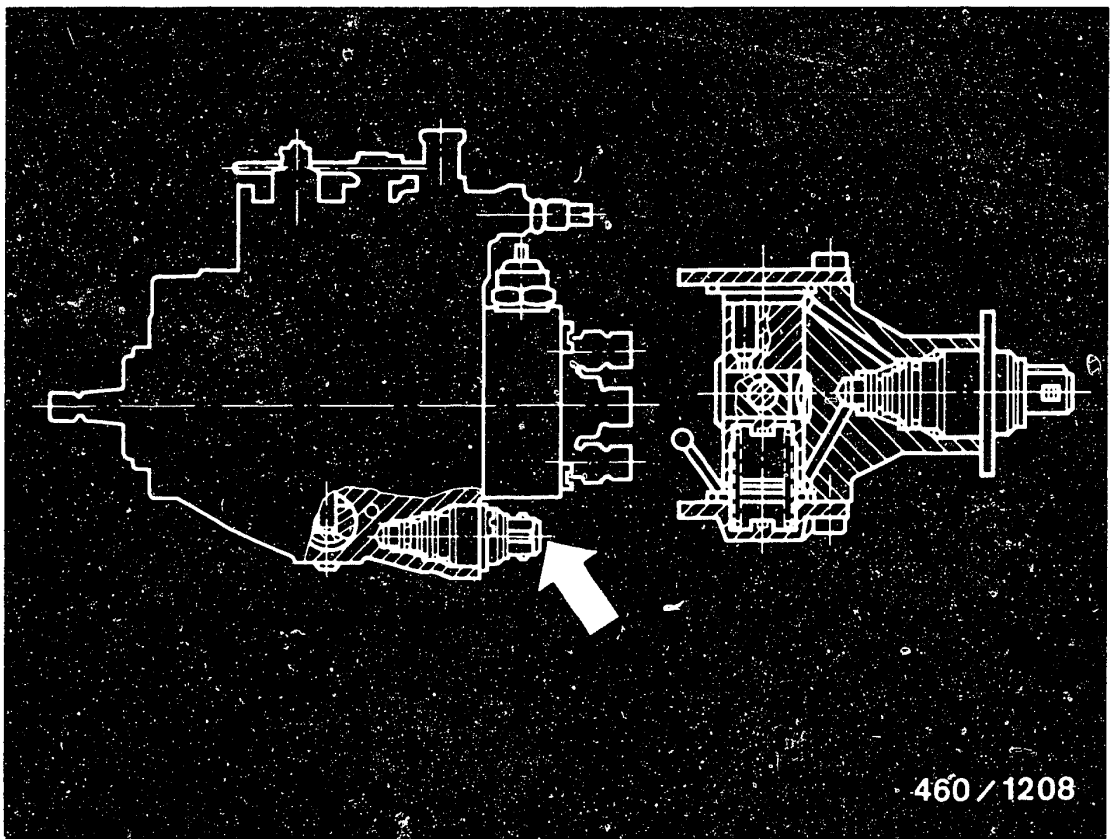
Note:

Glow plugs with burned elements

Glow plugs with burned elements are frequently the result of troubles with the injection nozzle.

If glow plugs are found to have burned elements (arrow), it is not sufficient simply to replace them. The injection nozzles must also be tested for spray pattern, chattering, pressure and leaks.





460 / 1208

## 32. TEST TIMING VALVE/TIMING DEVICE

### 1. Operation of closed-loop start-of-injection control

From the input variables of engine temperature, engine speed and needle-stroke signal, the control unit calculates a specific on/off ratio (= relative cyclic duration factor) for each operating state of the engine.

The timing valve (arrow) is energized with this on/off ratio (current pulses of variable length at fixed frequency, e.g. 50 Hz) and thus controls the pump interior pressure and the timing-device characteristic.



## Functional test (timing valve)

- - Run engine at idle speed and at normal operating temperature.
- Disconnect plug from plug board (charge-air pipe).
- Engine runs audibly rougher due to timing advance.

If the running of the engine does not become rougher, check lead and timing valve for continuity.

### Note:

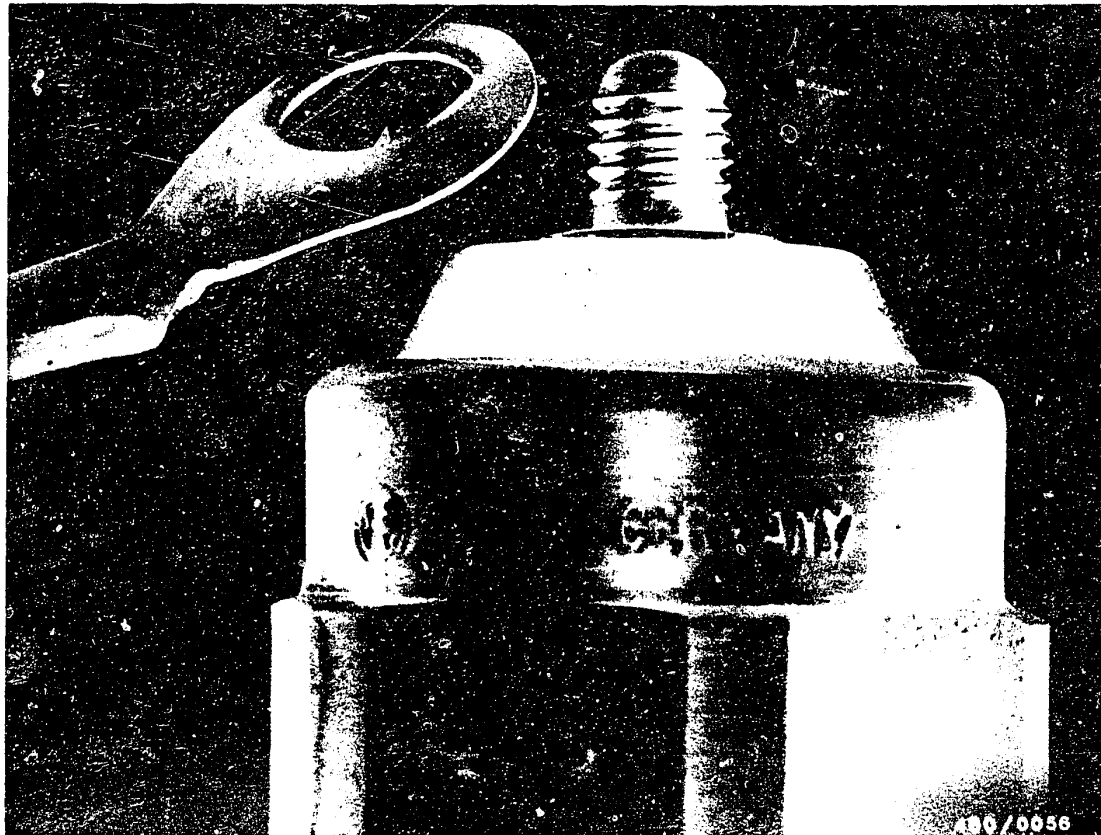
Due to poor accessibility of the timing valve, remove fuel-injection pump and replace timing valve.

2. On distributor-type fuel-injection pumps VE..F.. the timing device is integrated in the injection pump.

To test the timing device, it is necessary to remove the injection pump.

Testing is performed on the injection-pump test bench.





### 33. MEASURE ENGINE COMPRESSION AND COMPRESSION LOSS

#### 33.1 Measure engine compression

Fit new chart in compression tracer.  
Mount high-pressure hose on tracer.  
Switch off engine.

In order to prevent fuel from being injected, remove connecting cable from shutoff magnet on distributor-type fuel-injection pump (picture).

**G1**

Measure engine compression and comp. loss  
BMW 524 td



Unscrew sheathed-element glow plugs and use suitable connecting nipple for compression tester.

Using the starting motor, turn the engine over several times so that loose residues are removed from the compression space.

Screw in connecting nipple.

Mount high-pressure hose of compression tester on connecting nipple.

During the following operation, note first compression stroke

Operate starting motor until there is no longer any detectable rise in pressure on the compression tracer.

Bleed compression tracer by pressing on bleeder valve.

The pointer returns to the starting position.

Move chart onto next position.

Fit connection nipple to the other cylinders and repeat measurement.

Compression pressure:	approx. 24 bar
min.:	20 bar

Test conditions:	
Coolant temperature	max. 35°C



### 33.1.1 Evaluation of chart

#### 1. Normal pressure test

If piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase.

During the following compression strokes the compression builds up to the maximum pressure.

#### 2. Gradual pressure rise

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

#### 3. Low maximum pressure

If the maximum pressure obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.

If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder head gasket.



#### 4. Varying compression

If one cylinder shows a clearly lower compression, proceed as follows: fill in 2-3 cm<sup>3</sup> of engine oil through the opening of the sheathed-element glow plug or nozzle-holder assembly and operate starting motor briefly.

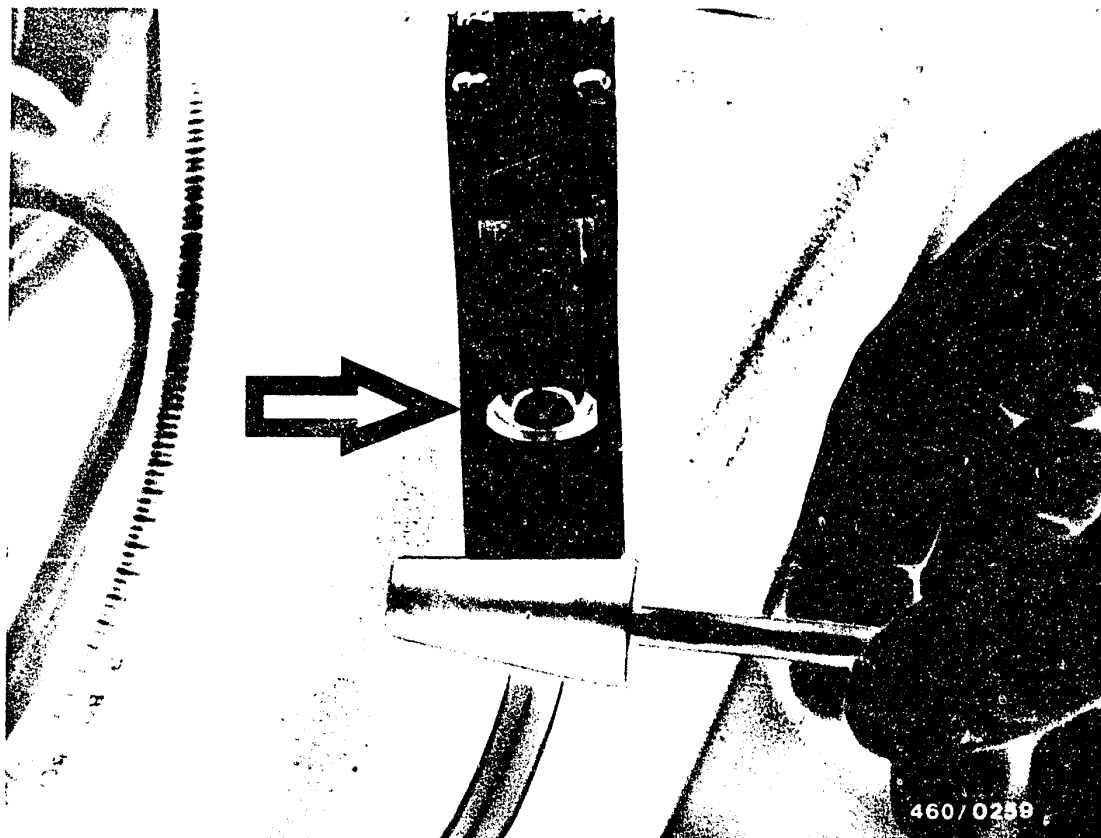
Repeat measurements and compare charts. If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn. If there is no change in the result, then defective valves are the cause.

#### 5. Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine. Maximum compression is, therefore, not the only objective.







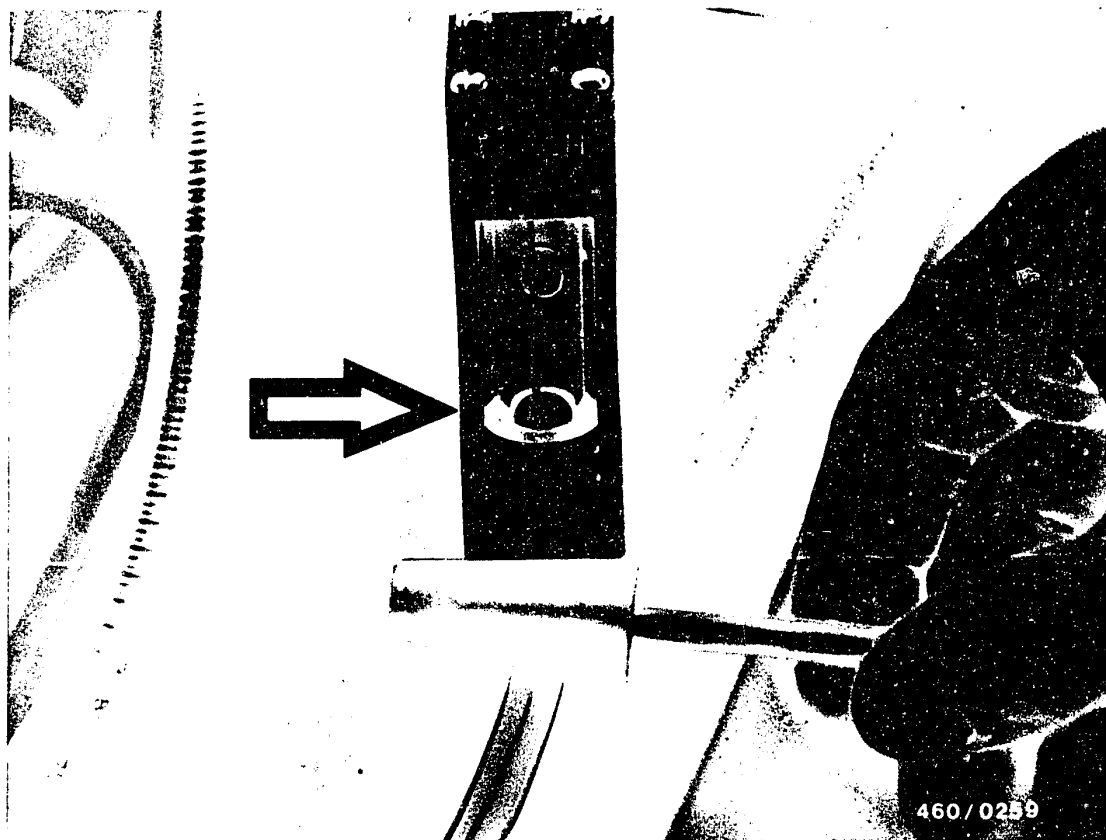
### 33.2 Measure compression loss of engine

The test is performed using the Bosch compression-loss tester 0 681 001 901 (EFAW 210 A).

For testing, the respective piston must be at TDC (TDC = top dead centre) on the compression stroke.

For setting this position, use DC detector 1 688 132 025 (included in accessories with compression-loss tester).

Perform test with engine at normal operating temperature (temperature of water approx. 80 °C).



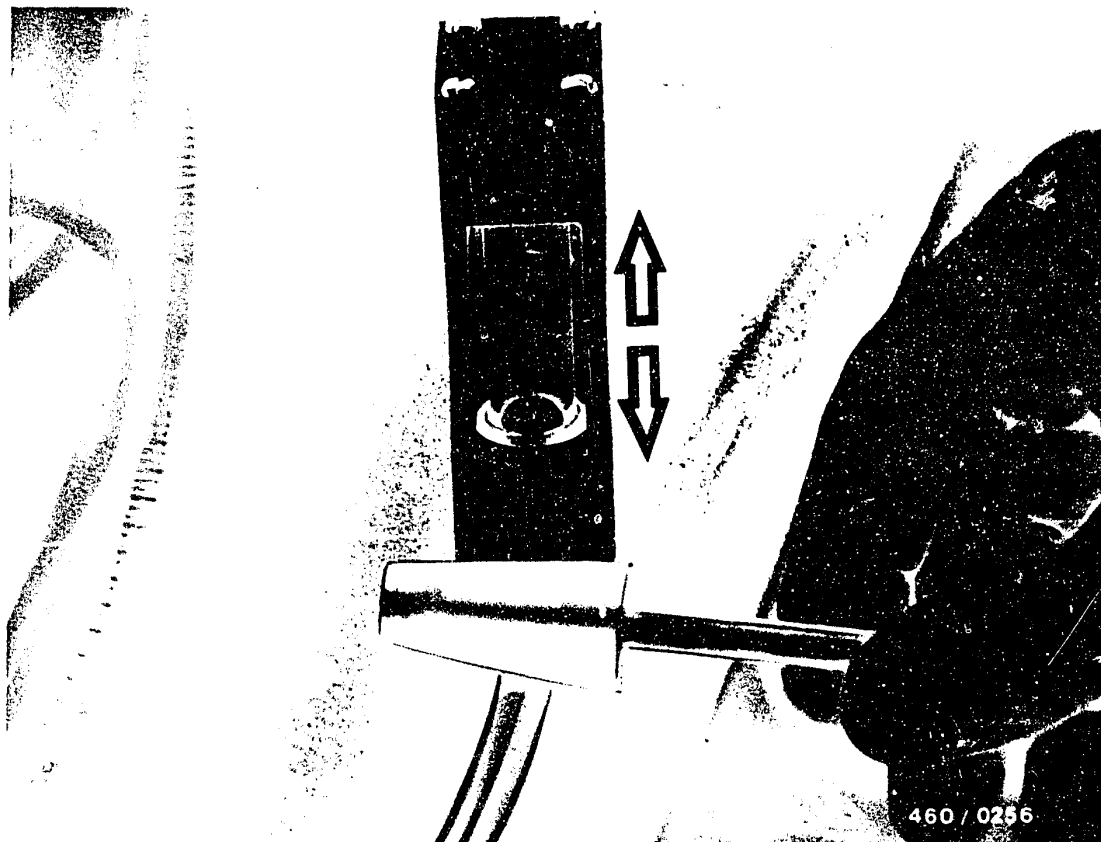
### 33.2.1 Set top dead centre

Remove sheathed-element glow plug from cylinder 1.

Insert rubber plug of DC detector into bore for sheathed-element glow plug.

Using magnetic clamp, mount glass cylinder in as vertical a position as possible in the engine compartment. The piston of the unit must be easily visible.

Slowly turn the engine over by hand in its direction of rotation. (If necessary, select gear and push vehicle).



On the compression stroke, the piston of the DC detector is forced upwards.

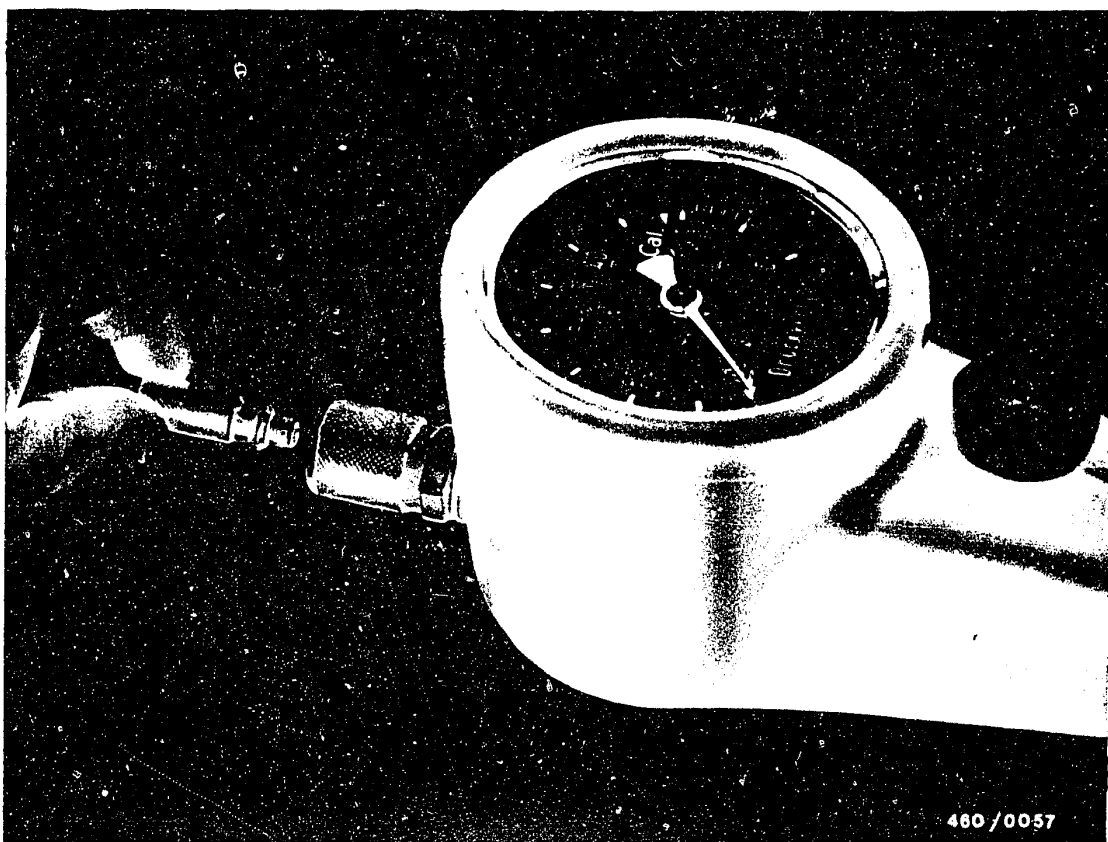
As top dead centre is passed over, the piston slides down again immediately.

Locate top dead centre by carefully turning the engine backwards and forwards.

**G7**

Measure engine compression and comp.loss  
BMW 524 td



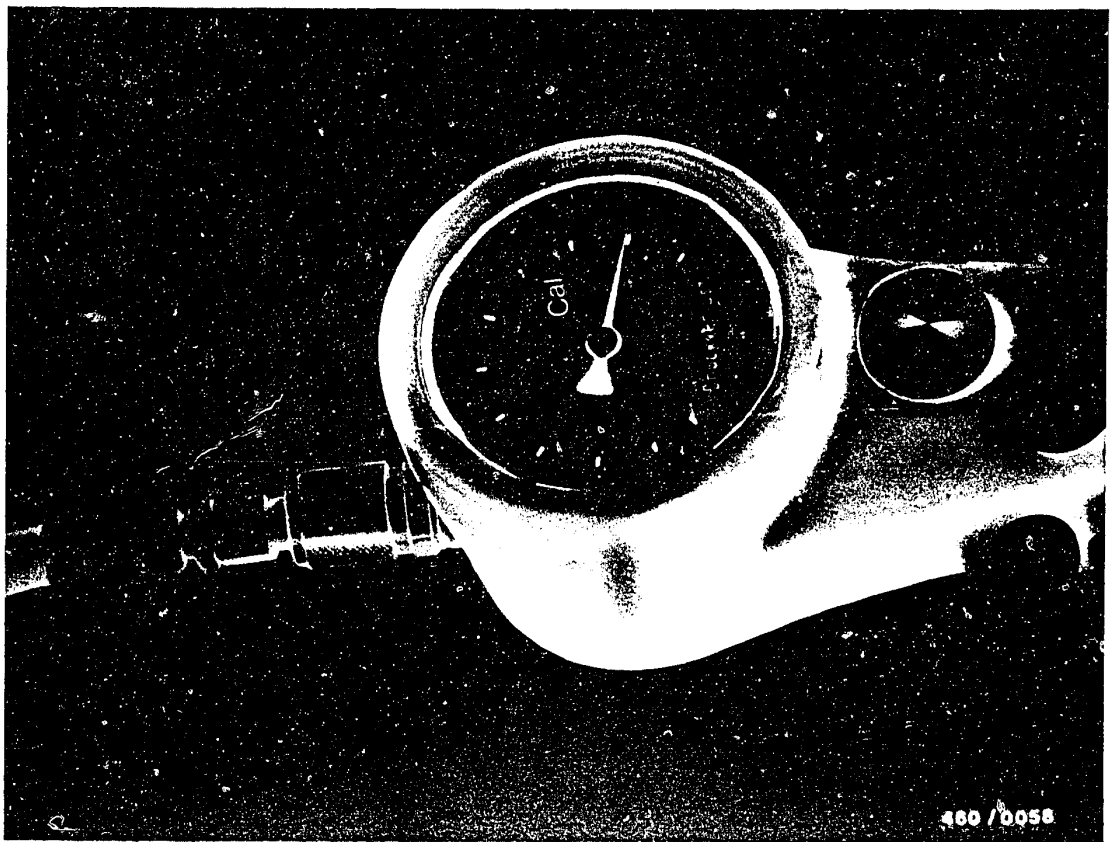


### 33.2.2 Measure compression loss

Connect tester to compressed-air mains.

Connect calibrating nozzle 1 680 363 036. Set a compression loss of  $23 \pm 1\%$  (marking "Cal".) at the knurled thumbscrew on the pressure-regulating valve. Disconnect calibrating nozzle.

Measuring-instrument pointer may deviate from zero point by plus/minus one graduation.  
Otherwise the tester is defective.



Screw in fitting and mount test hose.  
Select gear and pull on handbrake.  
Connect test hose to tester.  
Read off compression loss in % on instrument.

Note:

Before testing the next cylinder, turn the engine over briefly without pre-heating using the starting motor so that the oil film re-forms.

**G9**

Measure engine compression and comp.loss  
BMW 524 td



### 33.2.3 Evaluation of test

The compression loss indicated should not exceed 25%.

Differences of 10% between the individual cylinders can be ignored.

The causes of greater losses can be located because the air makes a noise as it escapes.

Listen at the following points:

<u>Location of noise</u>	<u>Possible trouble</u>
Intake manifold (remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filler neck on engine	Pistons, piston rings
Cooling water filler neck (air bubbles)	Cylinder head gasket

In order to trace the trouble even more accurately, fill approximately 2-3 cm<sup>3</sup> of engine oil into the cylinder. Repeat test.

If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5,000 km) may show higher compression losses than after the running-in period.





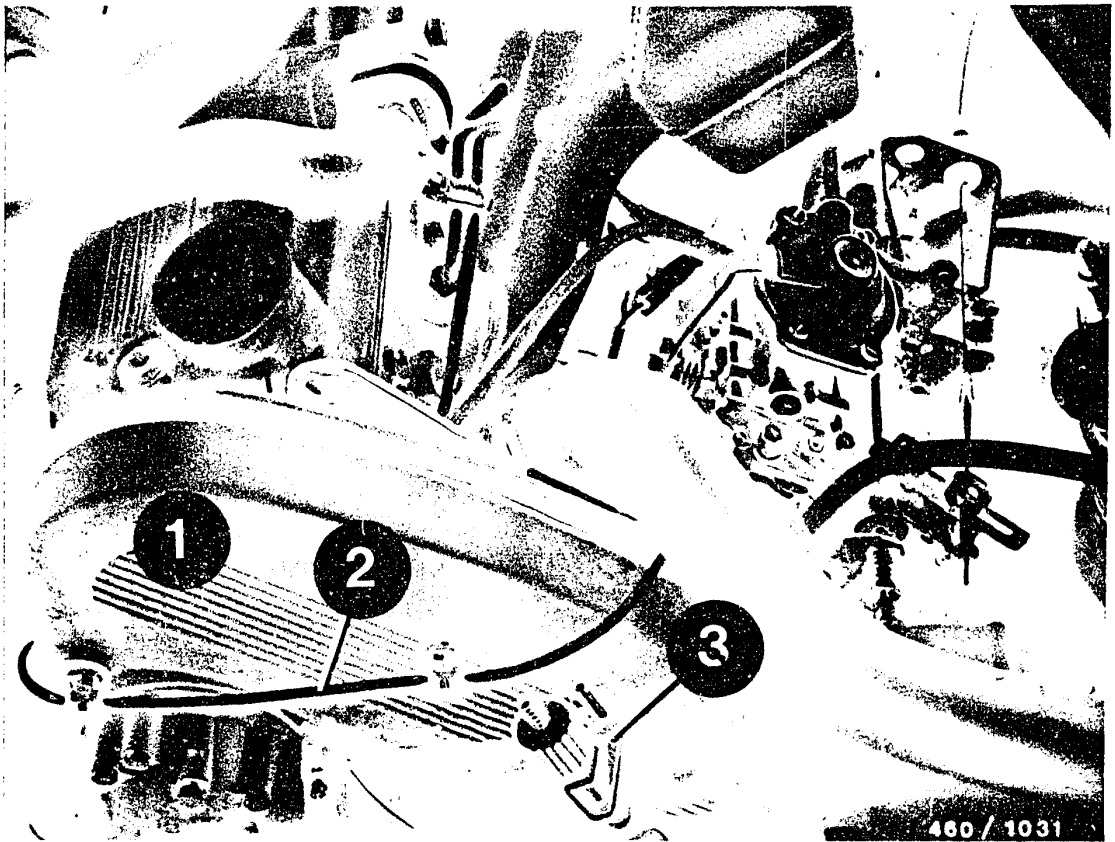
#### 34. REMOVE FUEL-INJECTION PUMP

Disconnect negative cable from battery.

Turn crankshaft until TDC mark (cylinder 1) on the pulley aligns with reference mark (arrow).

Piston of cylinder 1 is at TDC (valves of cylinder 6 on overlap).





1 = Toothed-belt cover  
2 = Wiring harness

3 = Hose clammer

Remove wiring harness.

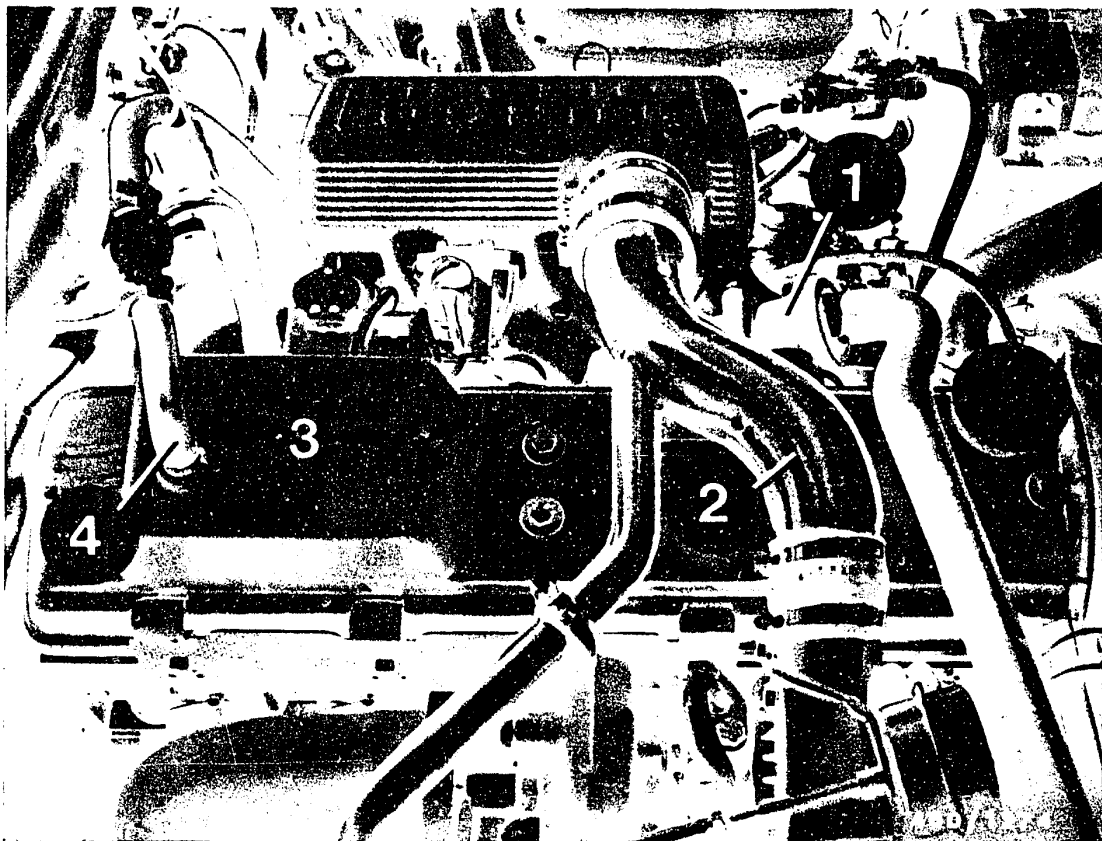
Pinch off cooling-water hose just after water pump using commercially available hose clammers.

Loosen hose clip and pull off cooling water hose.

Catch cooling water.

Remove toothed-belt cover.

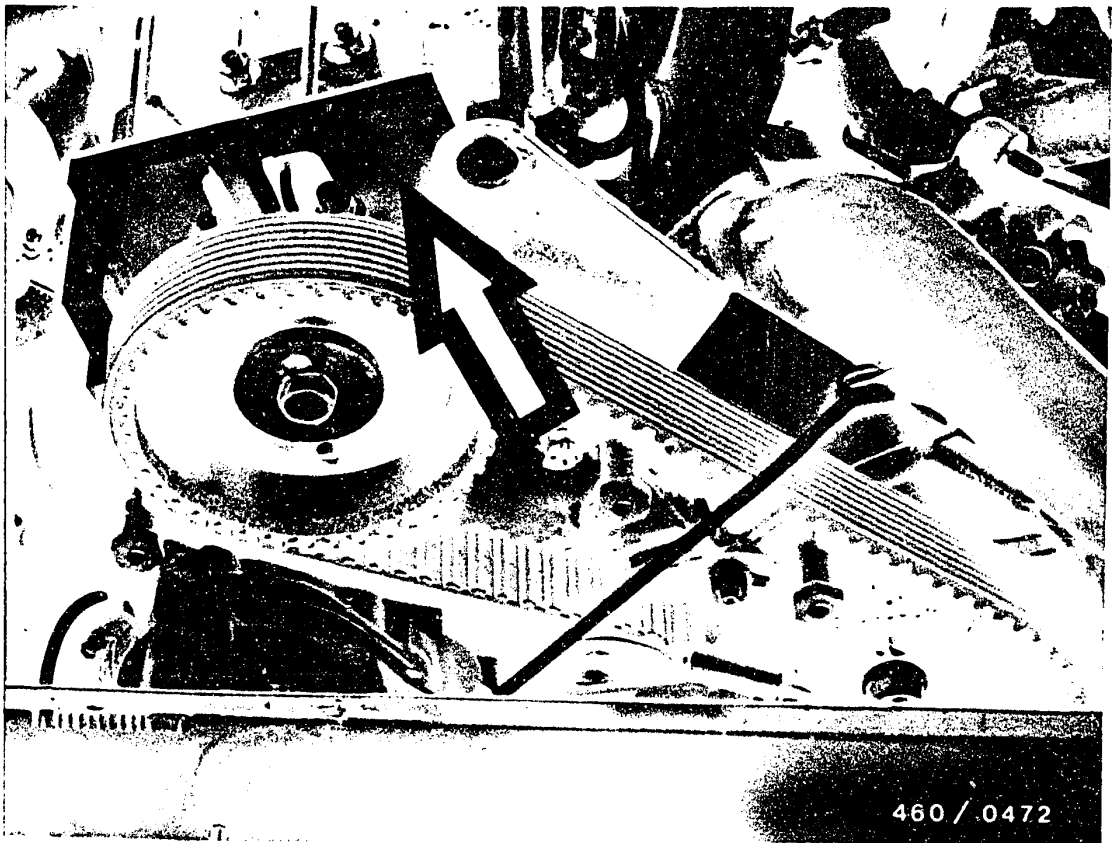




Remove crankcase ventilation pipe (1), connecting pipe between turbocharger and charge-air pipe (2) as well as cylinder head cover (3).

Disconnect vacuum hose from vacuum pump (4).





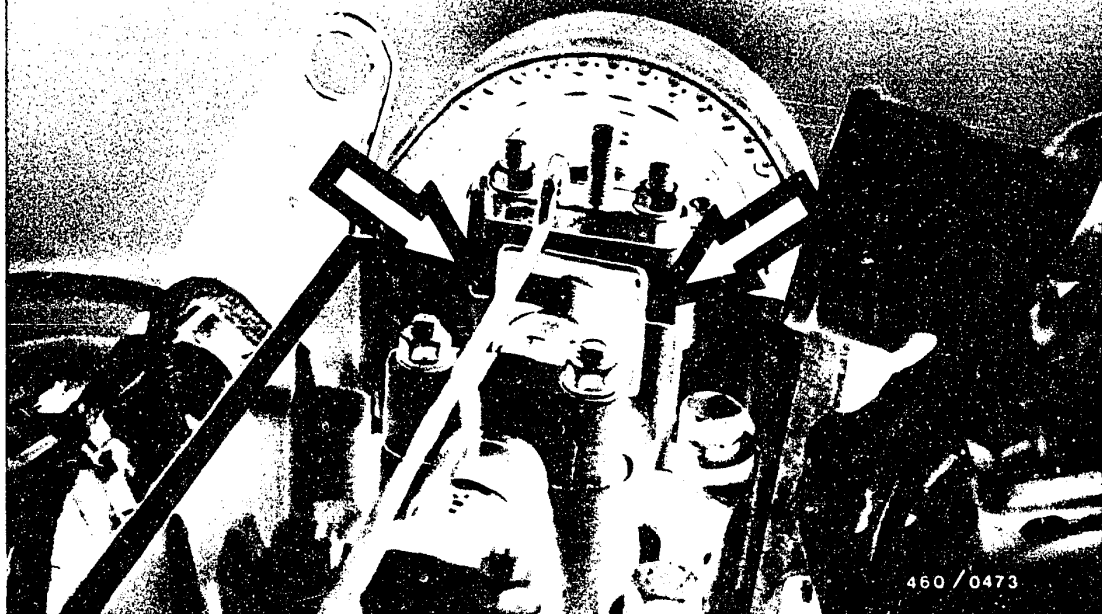
Lock the camshaft using locking device KDEP 1136 (arrow).

The valves of cylinder 6 are on overlap.

**G14**

Remove fuel-injection pump  
BMW 524 td





Note:

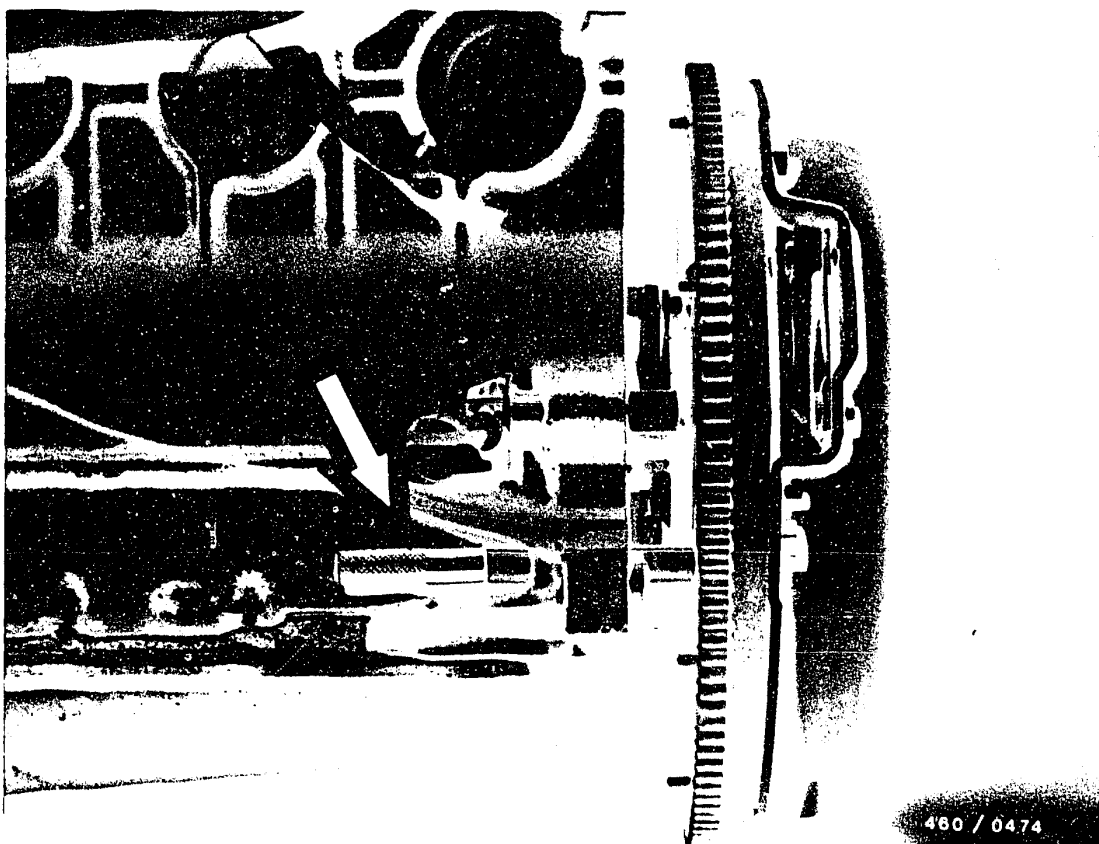
The locking device fits only over the two machined surfaces of the square (arrows).

**G 15**

Remove fuel-injection pump

BMW 524 td





Fix the flywheel in place using setting mandrel KDEP 1139 (arrow).

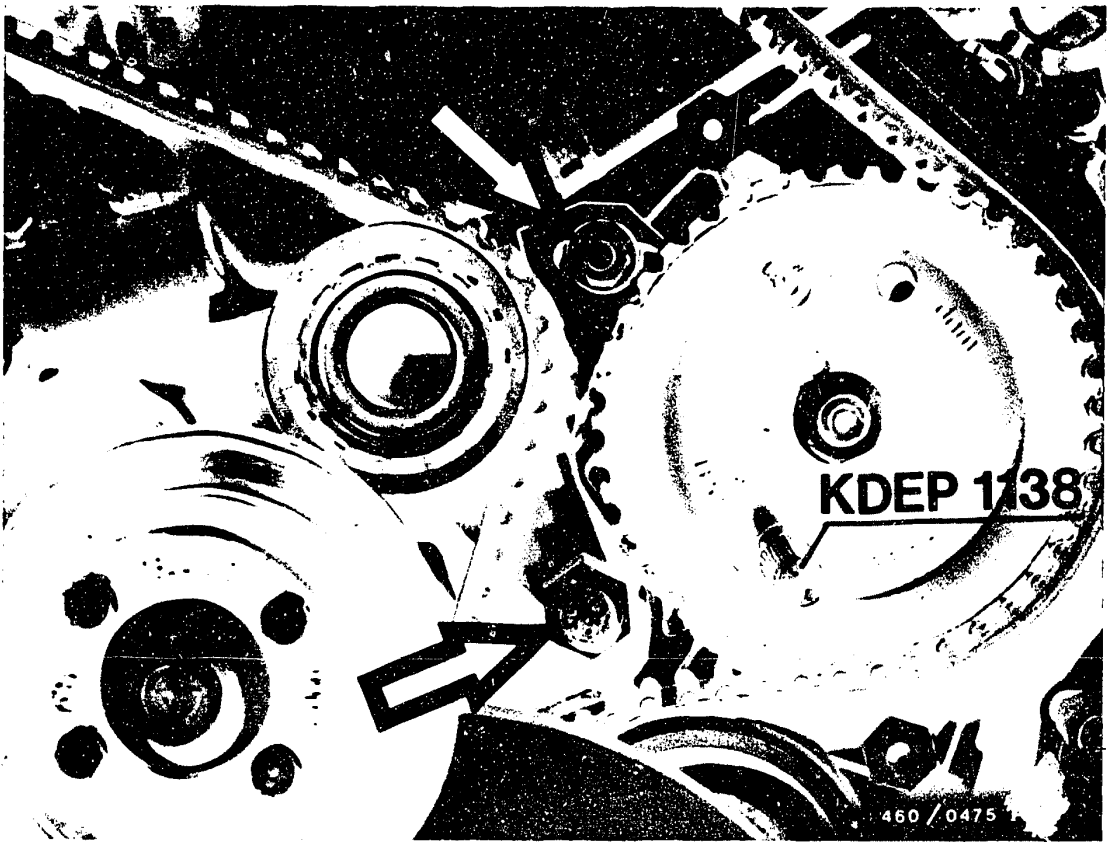
If the setting mandrel cannot be inserted, correct the engine timing.

**G16**

Remove fuel-injection pump

BMW 524 td





Lock the injection-pump gear using setting mandrel KDEP 1138.

Release the fastening nut/screw of the tensioning wheel bracket (arrows).

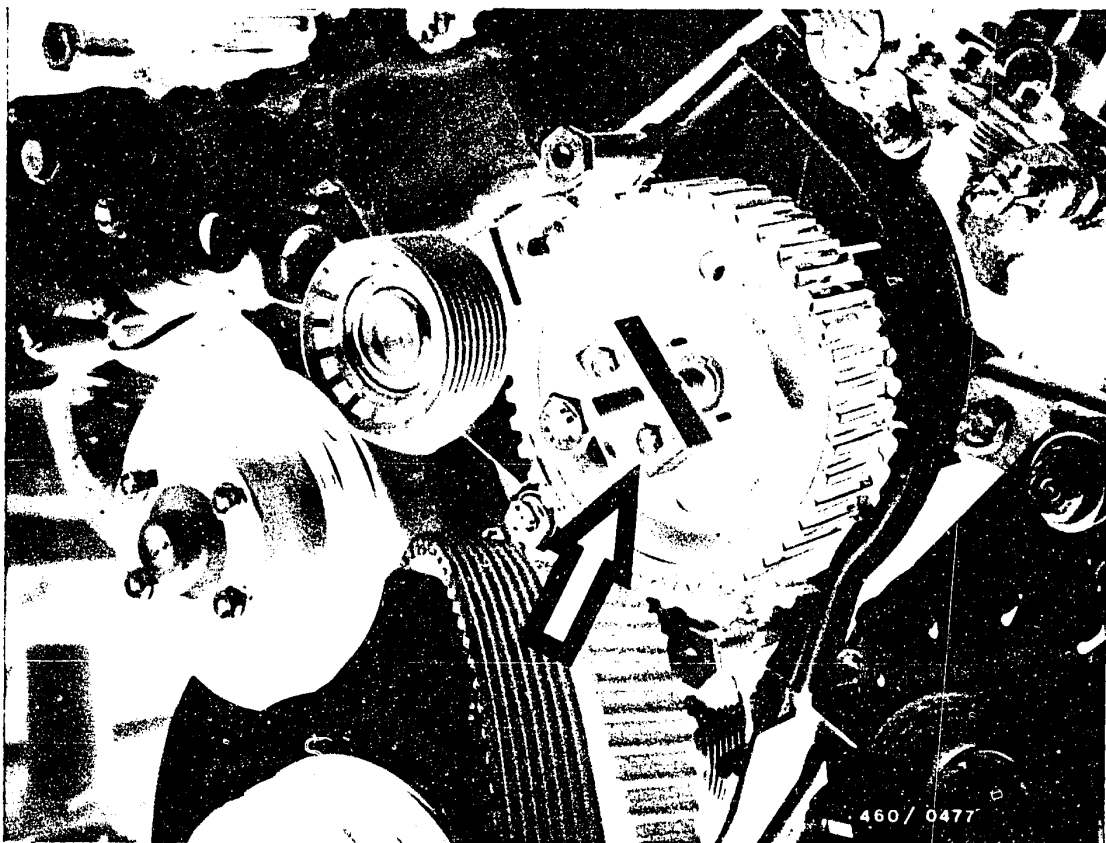
Relax toothed belt and remove.

**G17**

Remove fuel-injection pump

BMW 524 td





Mount puller KDEP 1137 on pump drive gear.

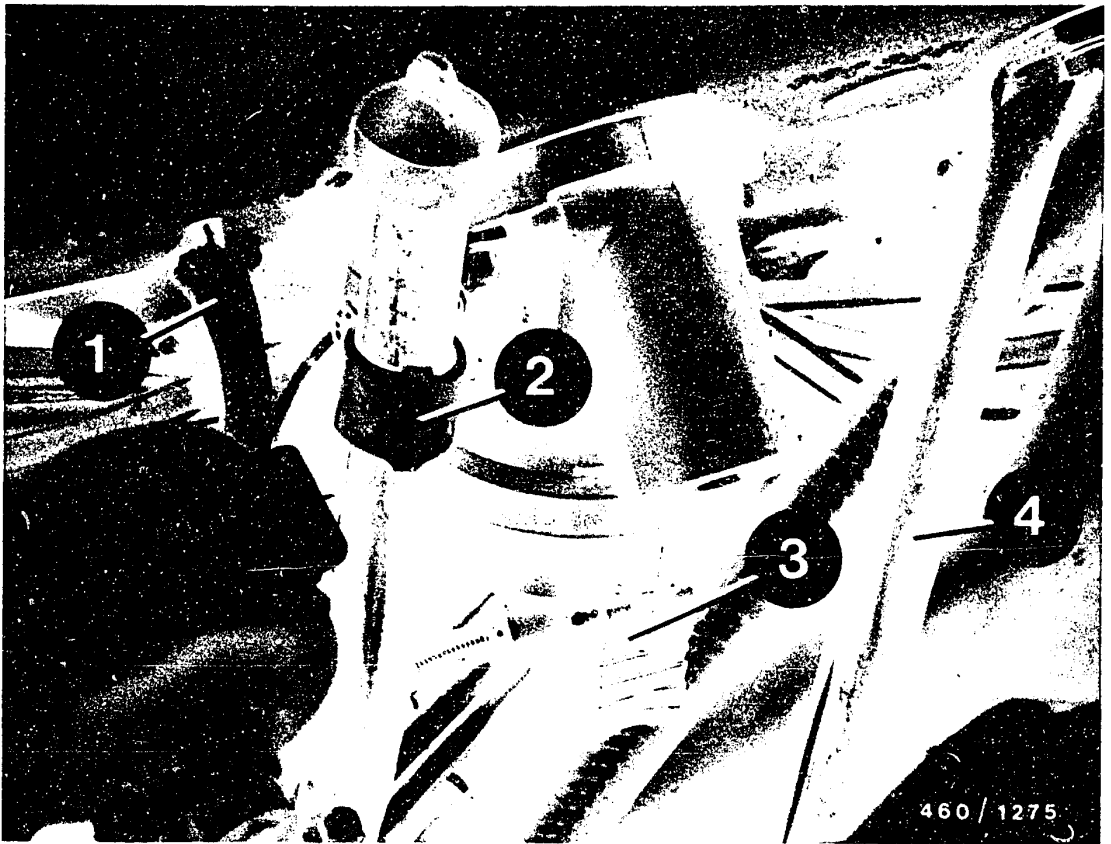
Loosen fastening nut on injection-pump gear.

Loosen pump drive gear from cone of drive shaft and remove injection-pump gear.

**G 18**

Remove fuel-injection pump  
BMW 524 td

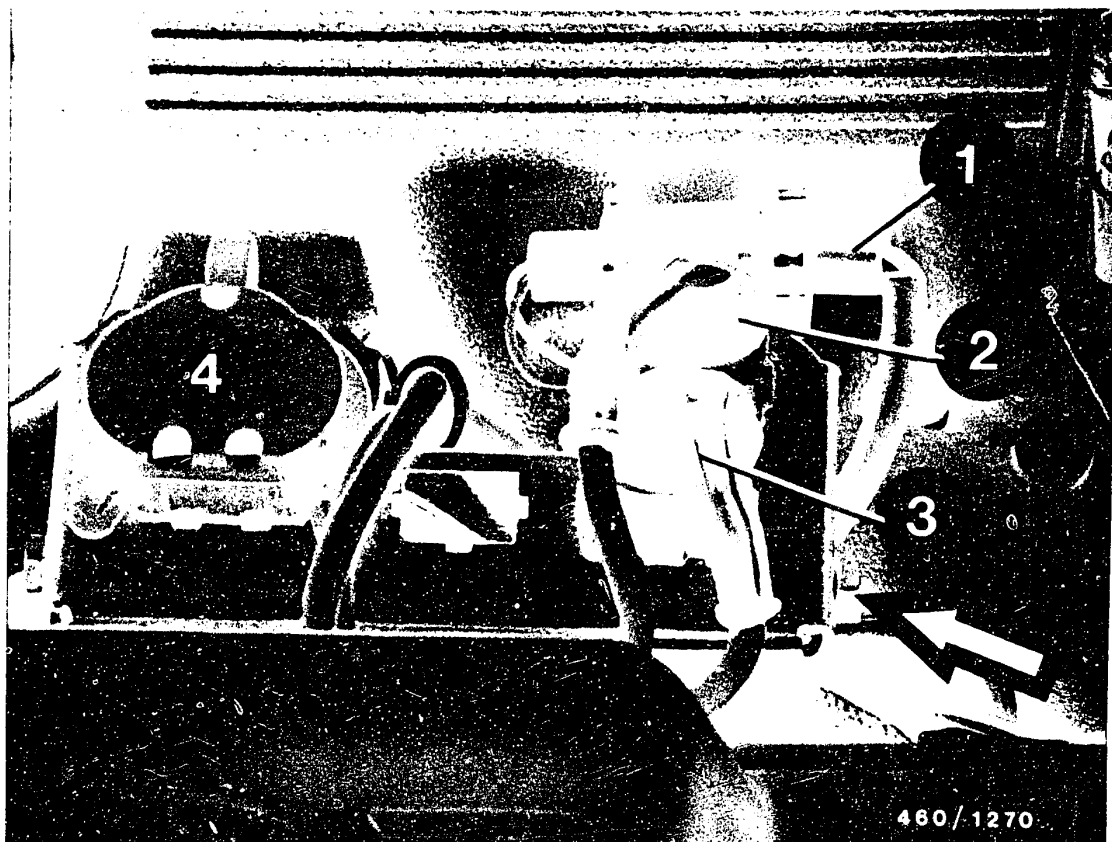




Remove hose line to ALDA \* (1), fastening clamp for oil dipstick (2), connector on blow-off valve (3) and support bracket for charge-air pipe (4).

\* ALDA = Altitude- and manifold-pressure compensator

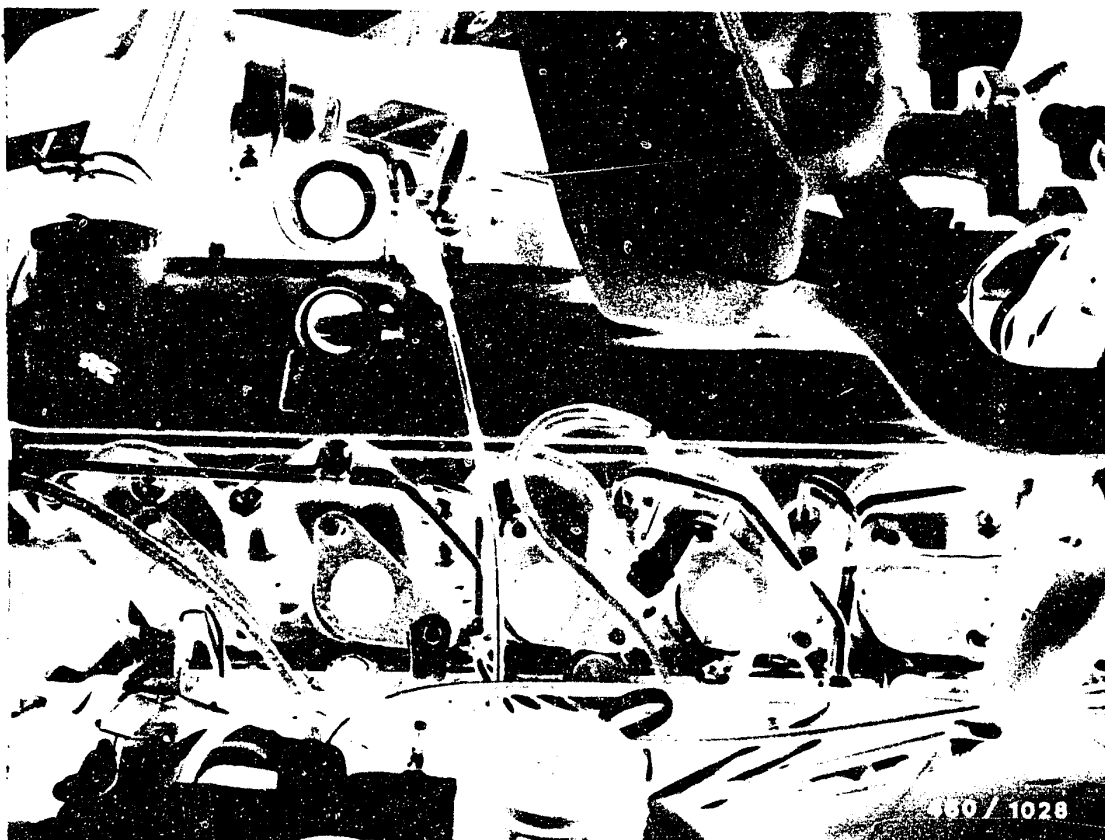




Take apart plug connector for timing valve (1), start of injection (2), engine-speed sensor (3), and pull plug halves including diagnostic plug (4) downward out of the plug board.

Loosen fastening screws (arrows) and remove plug board.





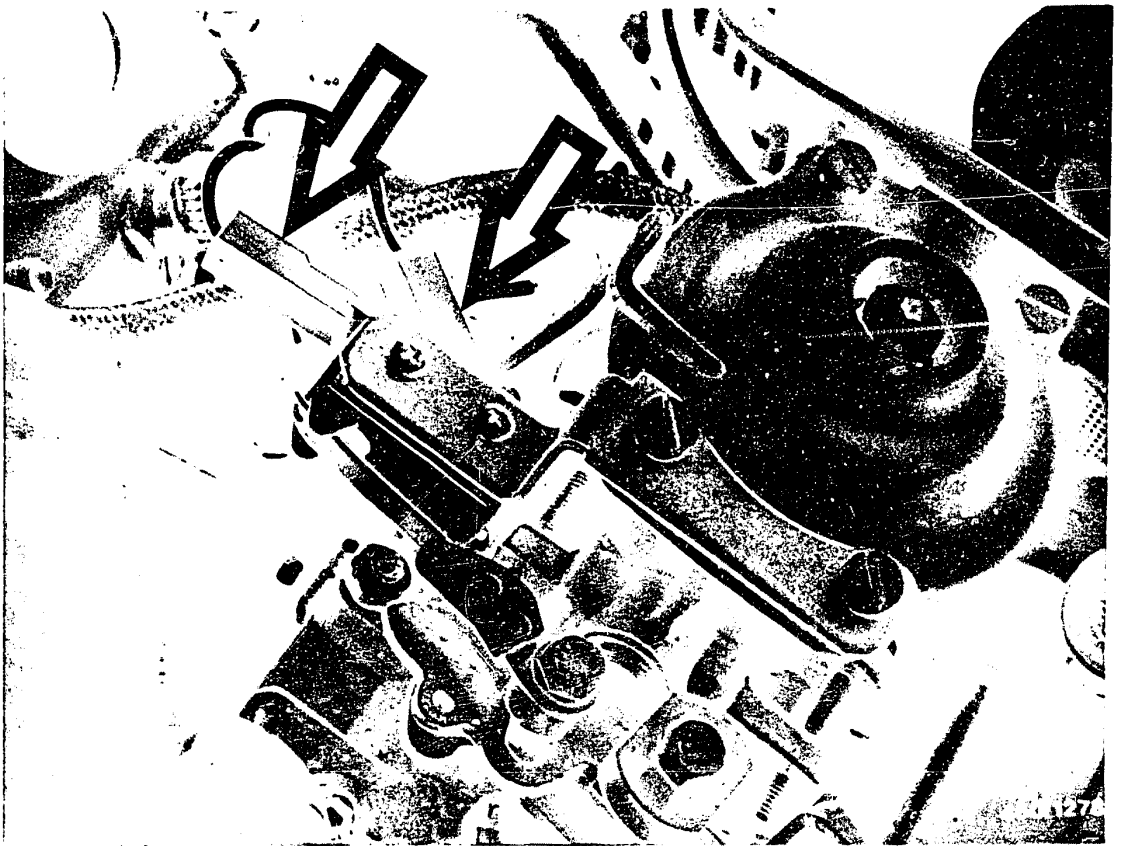
Take out the charge-air pipe and lay it to one side.

**G21**

Remove fuel-injection pump

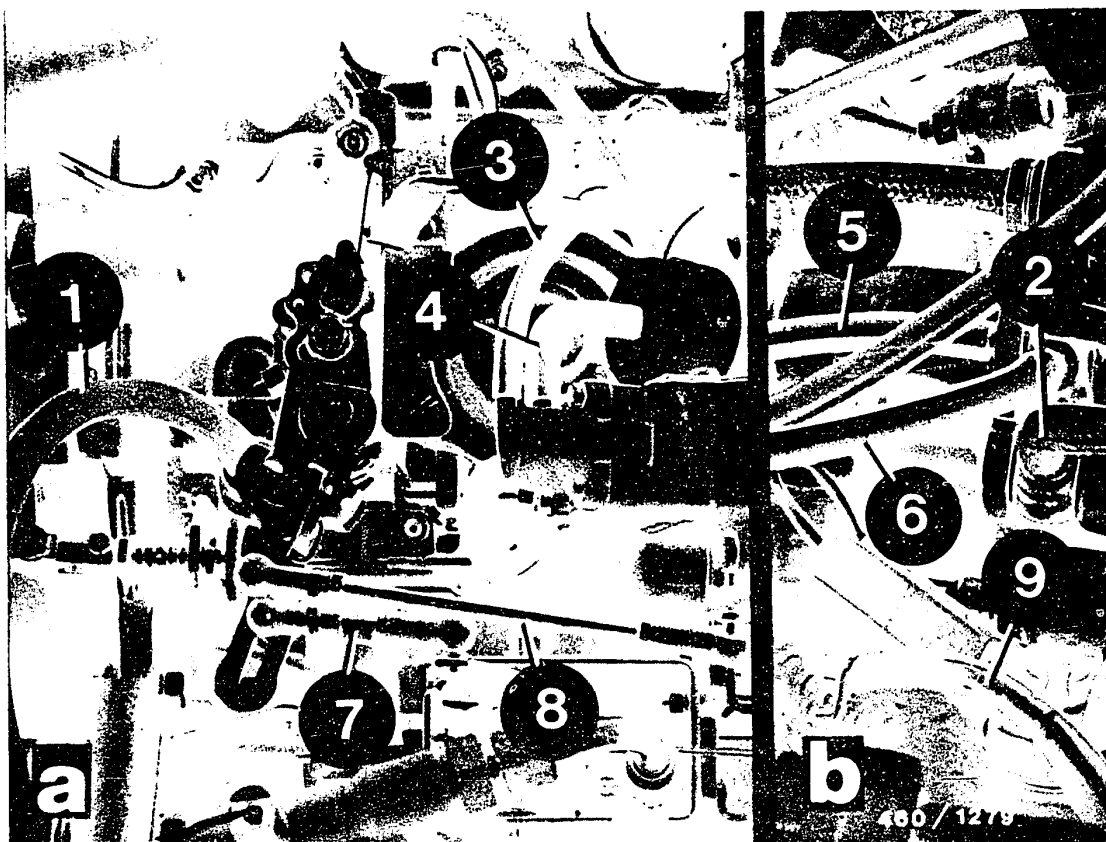
BMW 524 td





Disconnect connector from microswitch (arrows).



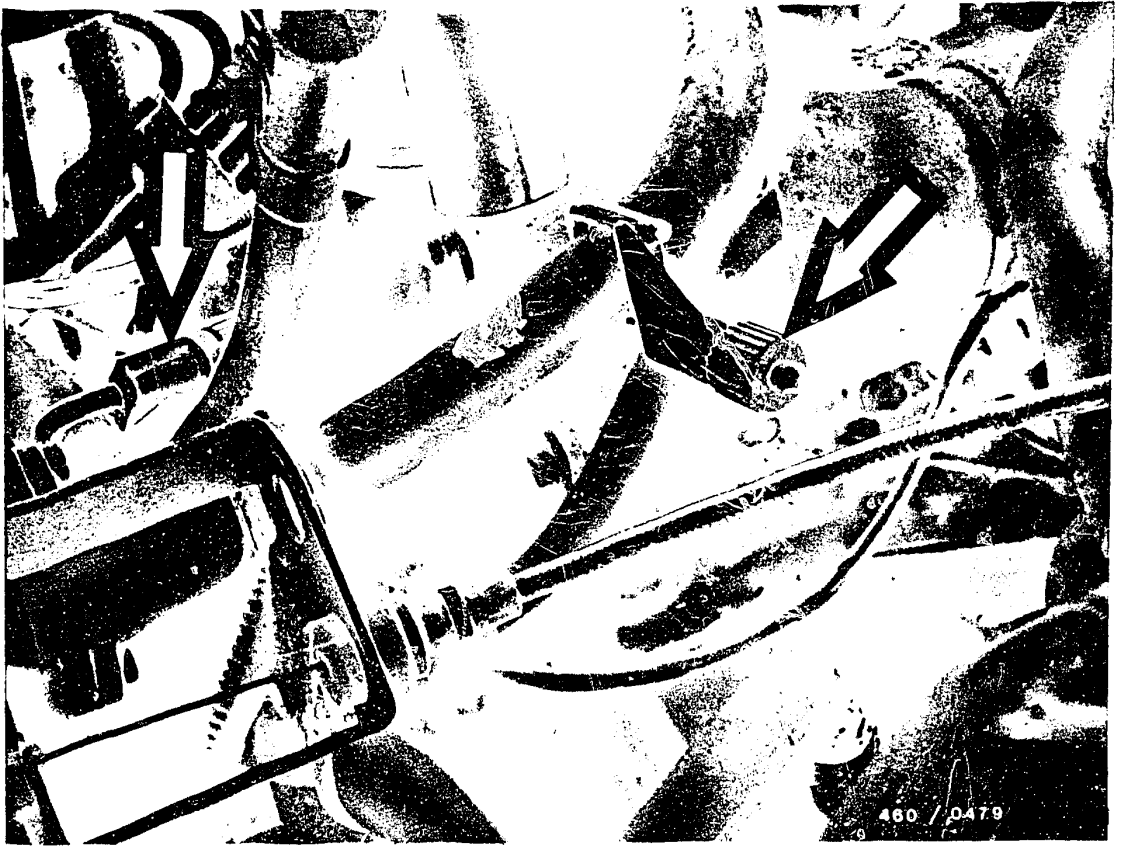


Remove fuel inlet line (1), return line (2), vacuum hoses (3), (4), (5) and (6), connecting rods (7) and (8) and cable for electrical shutoff device (9).

Note:

To prevent confusion, mark vacuum hoses/connection ports.





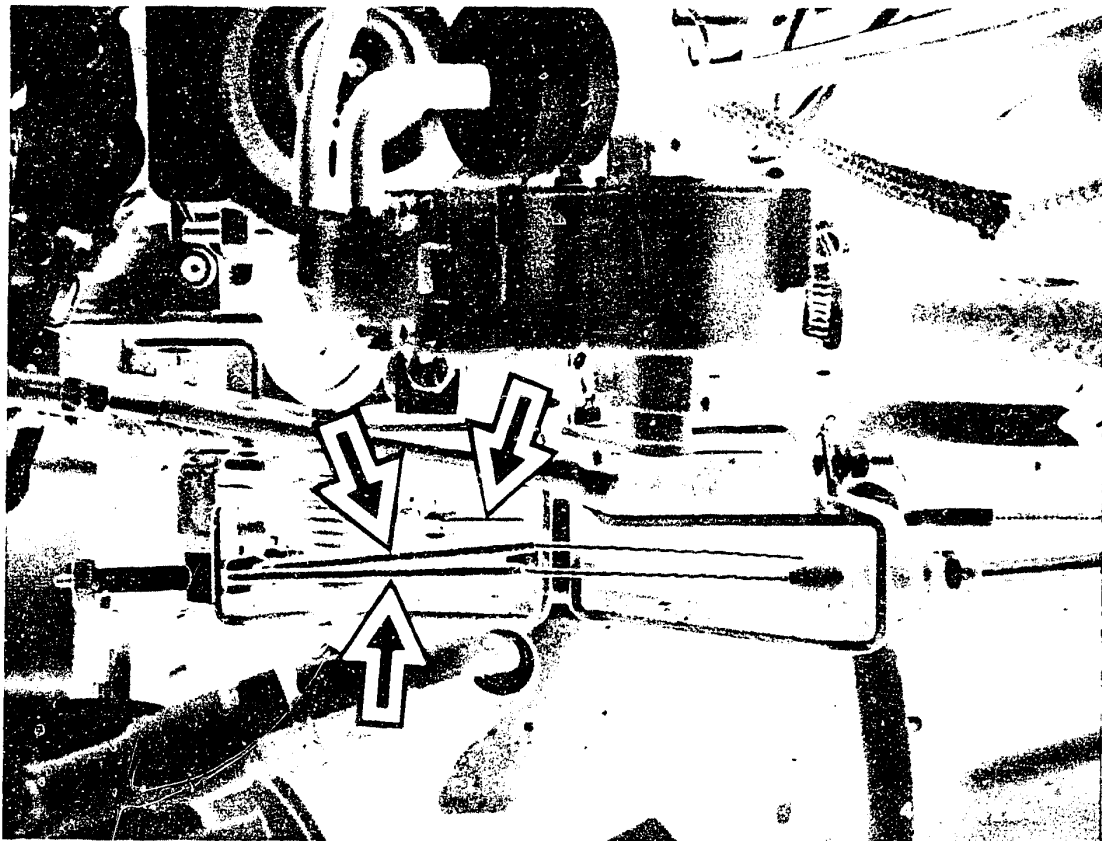
Pinch off cooling water hoses just after the control device of the injection pump using commercially available hose clampers (arrows).

**G24**

Remove fuel-injection pump

BMW 524 td



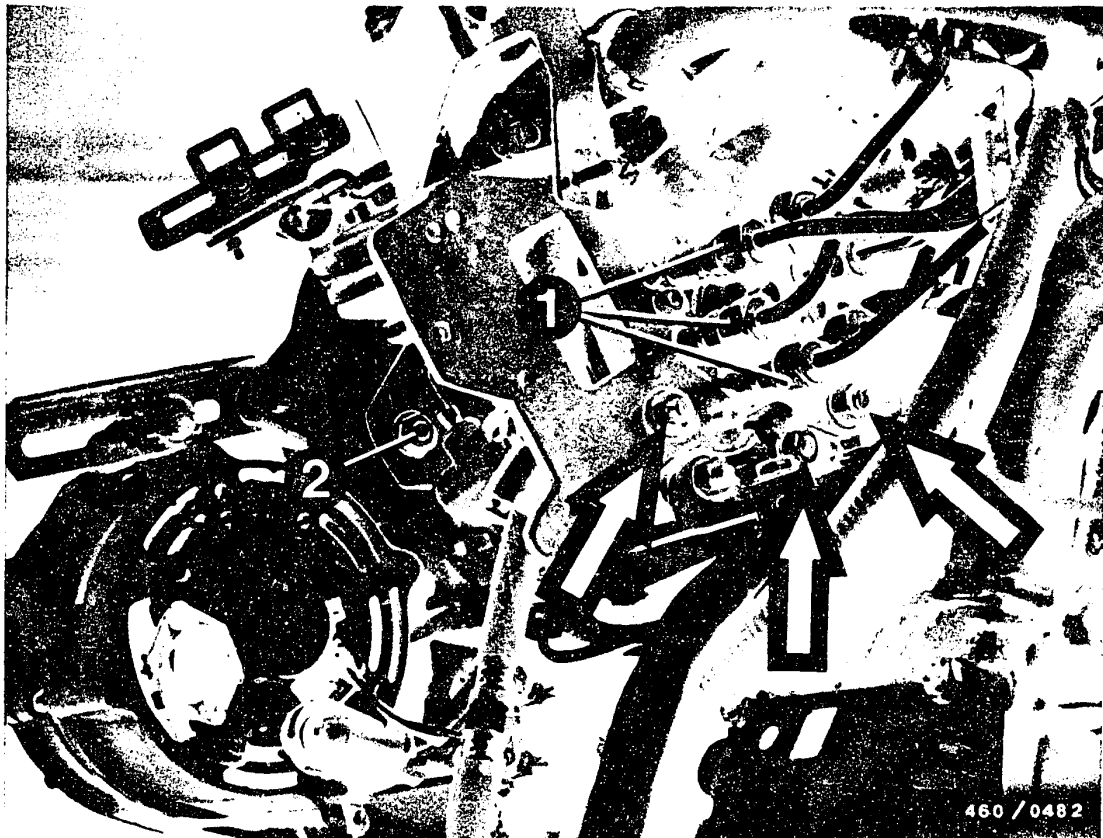


Unhook cable (arrows).

**H1**

Remove fuel-injection pump  
BMW 524 td





1 = Injection lines

2 = Fastening screws of injection pump

Arrows = Fastening screws of support bracket

Loosen the injection lines with an open box wrench KDEP 1115.

Prevent the delivery-valve holders from coming loose by holding with an appropriate tool.

Unscrew fastening screws of injection pump support bracket (arrows).

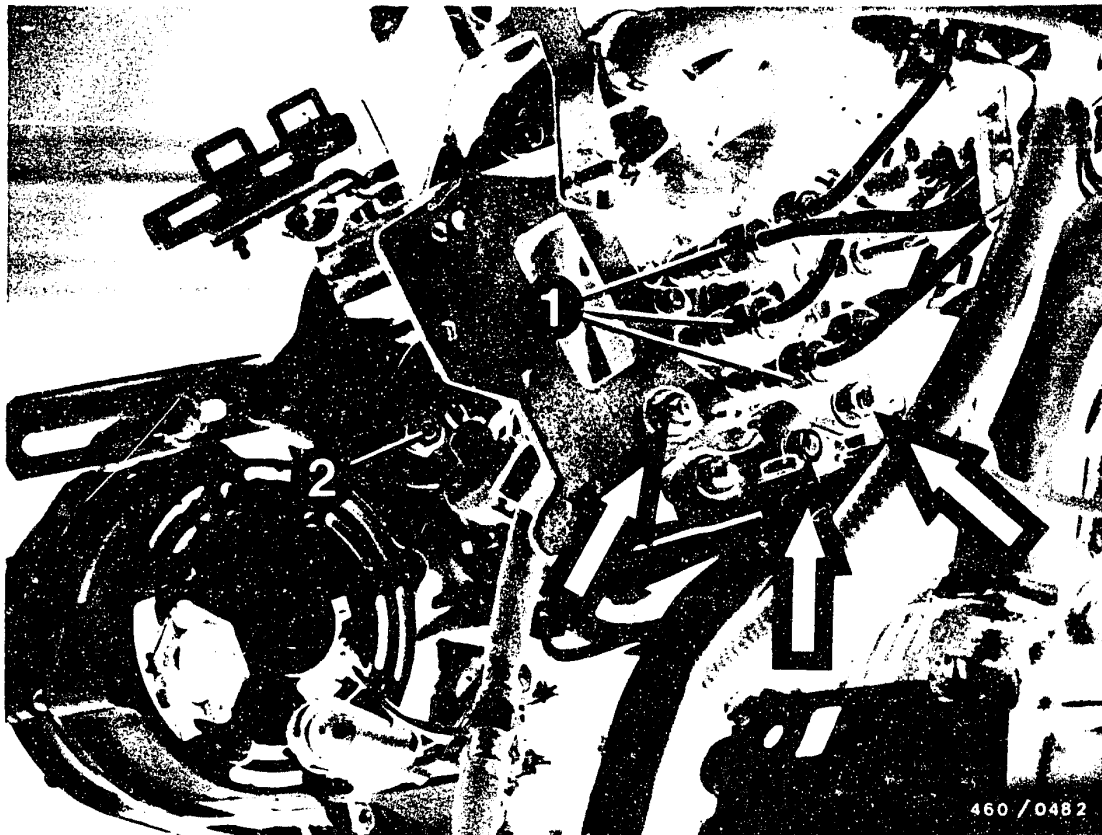
Remove fastening screws of injection pump on pump flange and remove injection pump.

**H2**

Remove fuel-injection pump

BMW 524 td





1 = Injection lines

2 = Fastening screws of injection pump

Arrows = Fastening screws of support bracket

### 35. INSTALL FUEL-INJECTION PUMP

Introduce injection pump into pump flange and finger-tighten fastening screws.

The 2nd fastening screw is not visible in the picture.

Mount support bracket on hydraulic head of injection pump using 3 nuts (arrows).

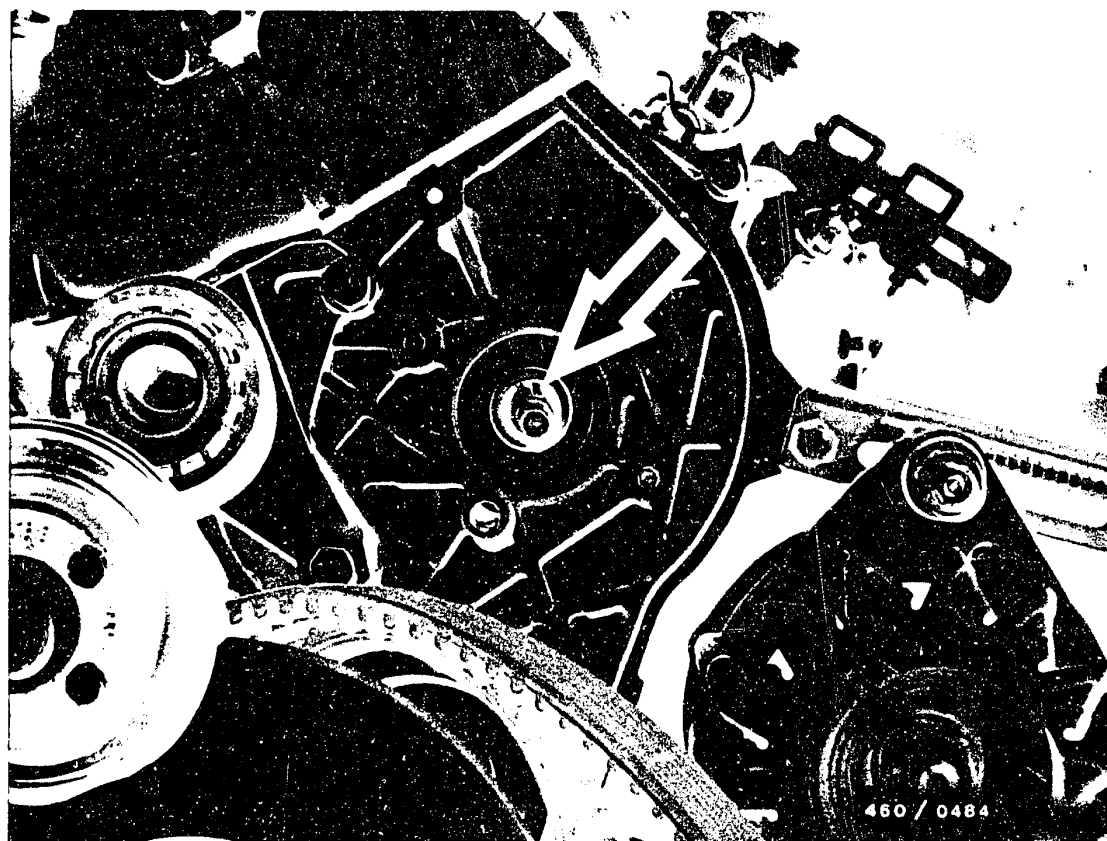
Do not tighten fastening screws.

**H3**

Install fuel-injection pump

BMW 524 td





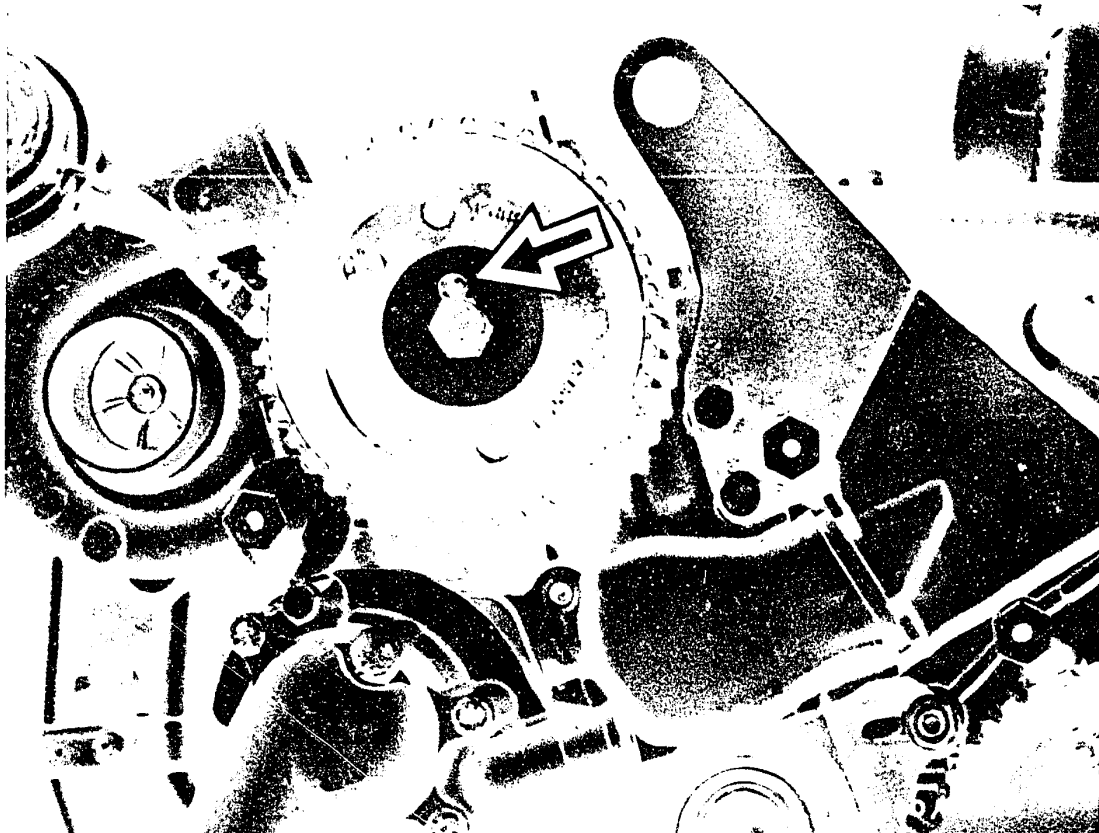
Mount injection-pump gear (Woodruff key in cone of pump drive shaft (arrow) must be installed).

**H4**

Install fuel-injection pump  
BMW 524 td







Loosen camshaft gear fastening screw.

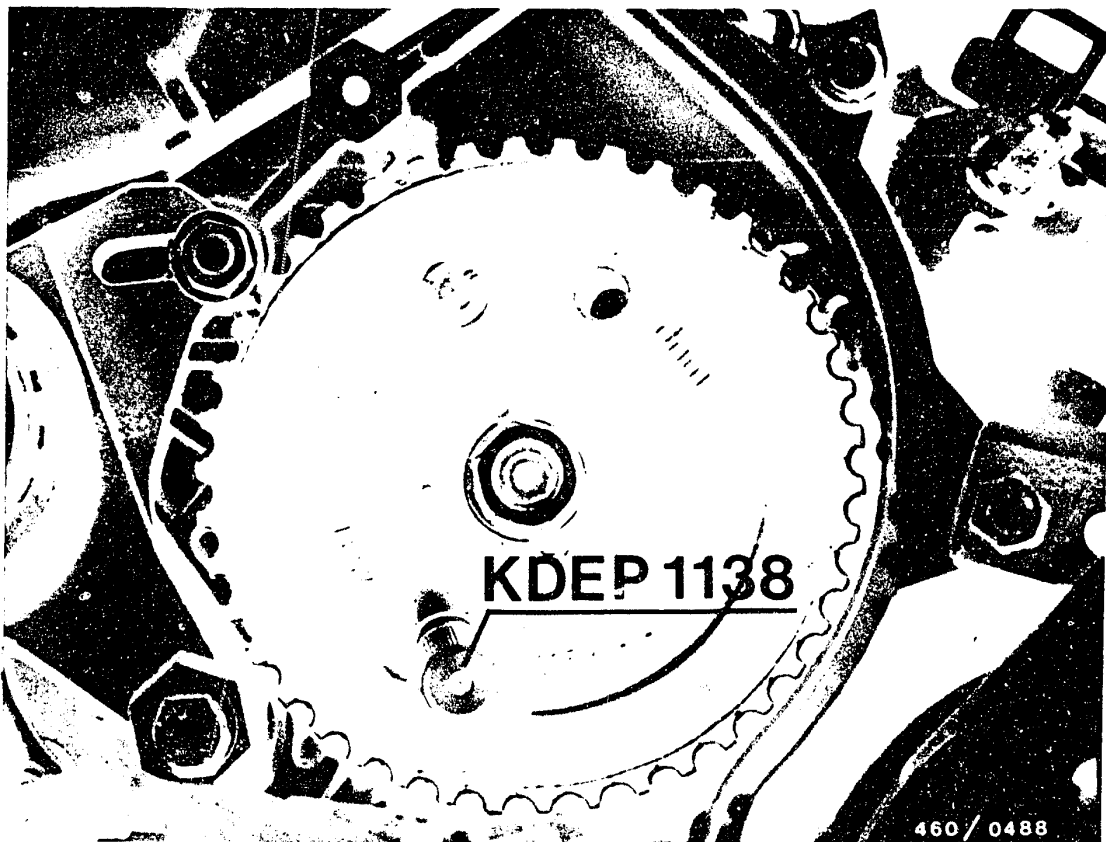
Bring camshaft gear to stop against the pin in its running direction (arrow).

Loosen camshaft gear fastening screw by hand.

**H5**

Install fuel-injection pump  
BMW 524 td





Lock injection-pump gear using setting mandrel KDEP 1138.

Tighten fastening nut to 45 Nm

Place toothed belt in position.

Notes:

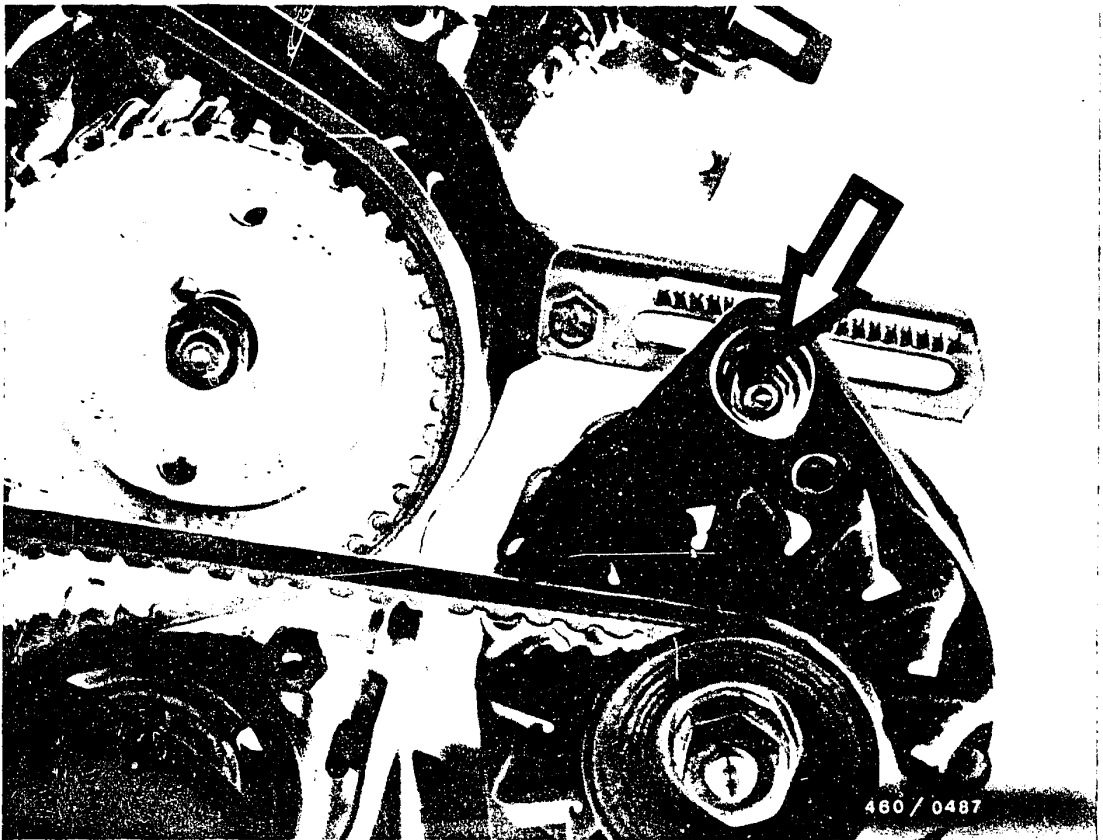
- If a used toothed belt is to be re-used, it may only be mounted in the previous running direction.
- Take out and replace porous or worn-out toothed belts. If a toothed belt is not being replaced, then continue at Coordinate H 15.

Never turn the crankshaft or camshaft without the toothed belt mounted so that the valves do not hit the pistons.

**H6**

Install fuel-injection pump  
BMW 524 td





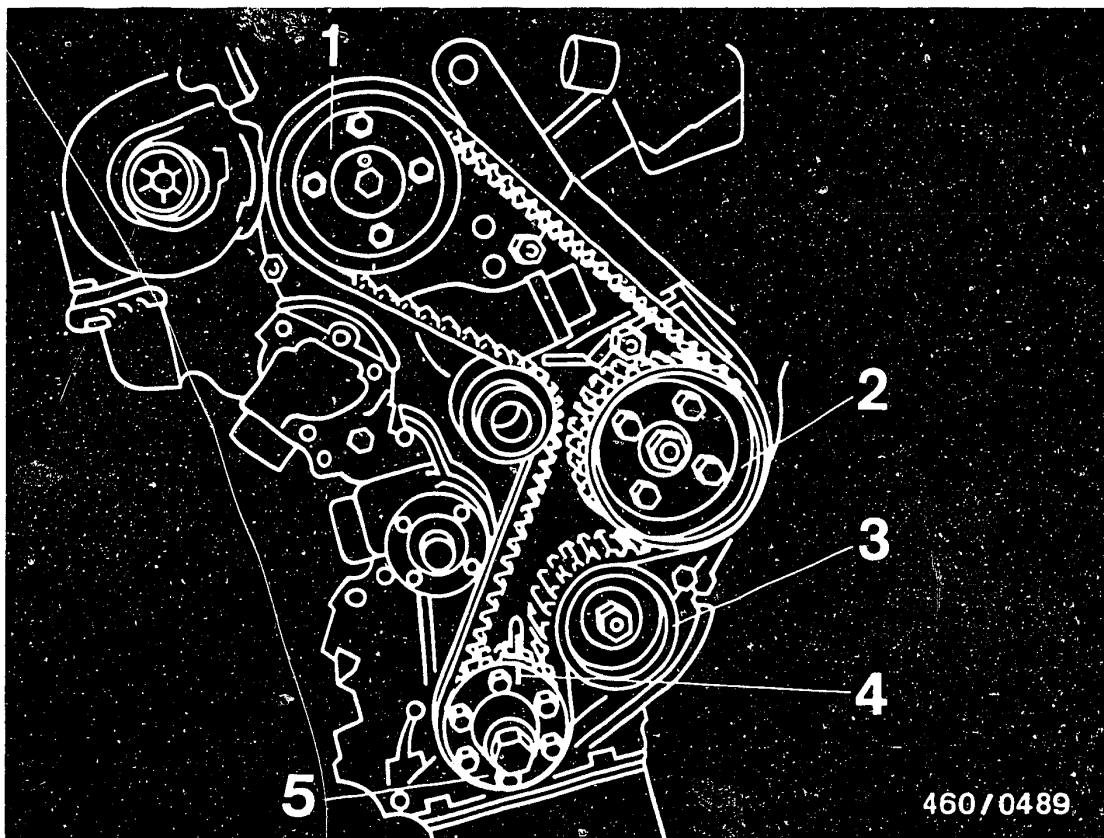
### Replace toothed belt

Loosen fastening screw (arrow) on alternator and remove V-belt.

**H7**

Install fuel-injection pump  
BMW 524 td





- 1 = Camshaft gear
- 2 = Injection-pump gear
- 3 = Toothed-belt pulley of intermediate shaft
- 4 = Mark on vibration damper
- 5 = Vibration damper hub

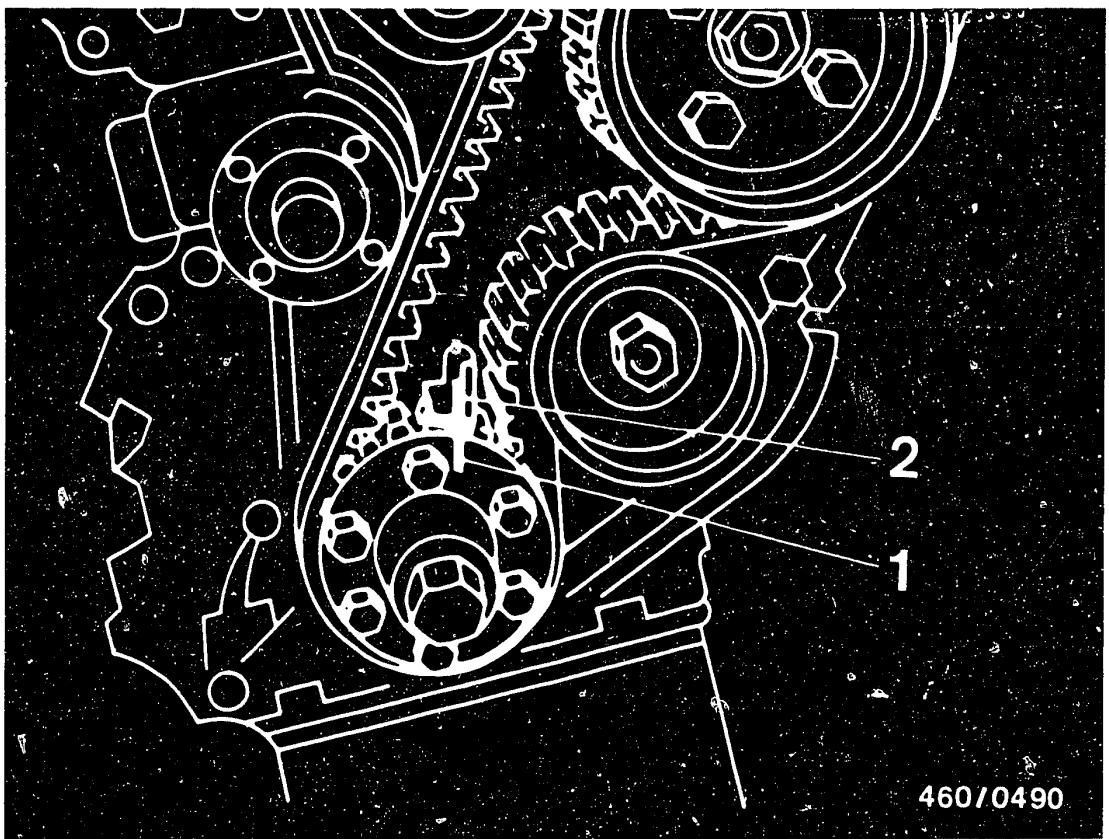
Remove the V-belt pulley (vibration damper) from the vibration damper hub on the crankshaft.

Removed toothed belt.

**H8**

Install fuel-injection pump  
BMW 524 td





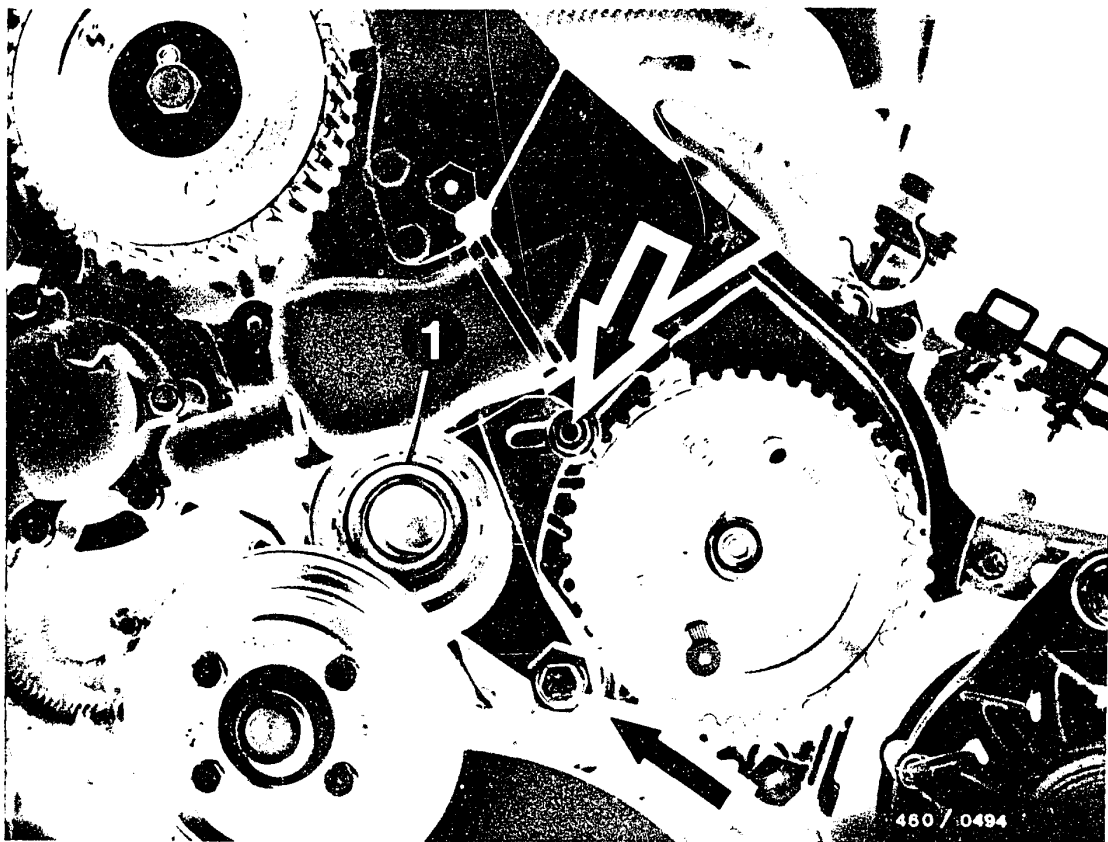
- 1 = Mark on vibration damper  
2 = Reference mark on toothed belt cover

Before mounting the toothed belt, check whether the mark on the vibration damper hub of the crankshaft is in alignment with the reference mark on the rear toothed belt cover.

**H9**

Install fuel-injection pump  
BMW 524 td





1 = Tensioning roller

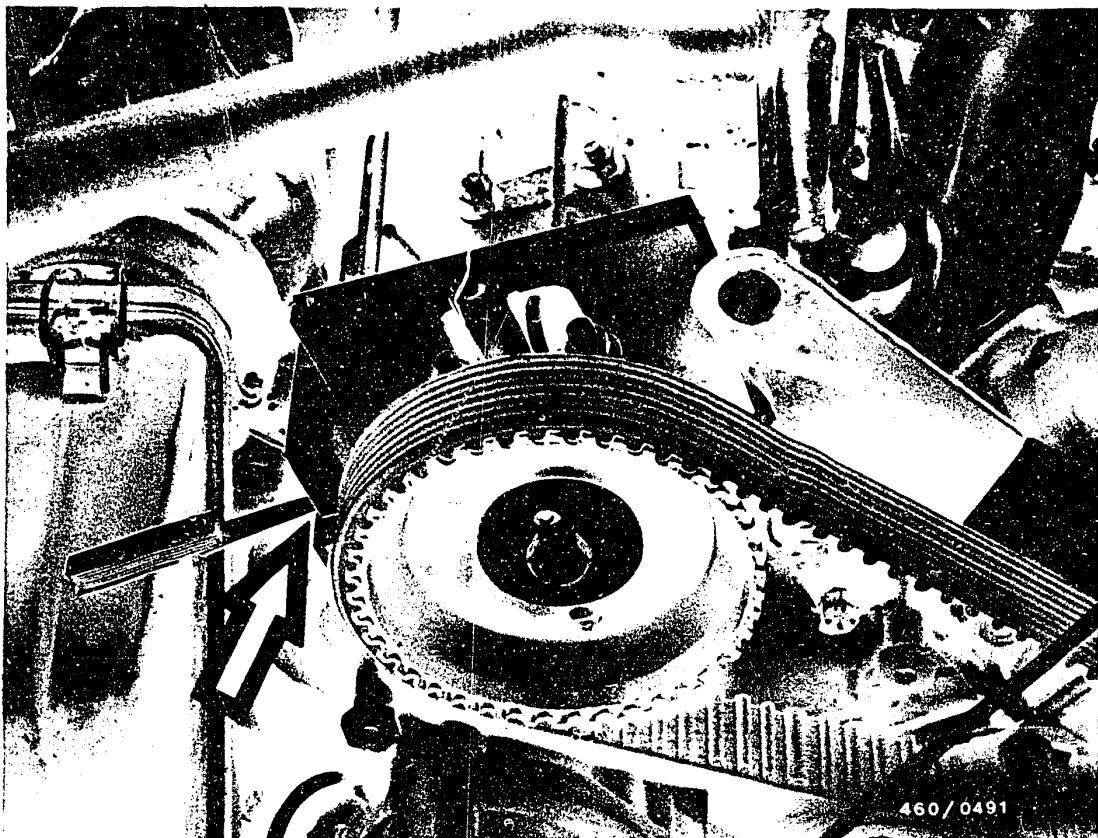
Finger-tighten the fastening nut and screw for the tensioning wheel bracket (arrows).

Starting from the crankshaft gear, place the toothed belt in the teeth of the injection-pump gear and, still under tension, over the camshaft gear.

**H10**

Install fuel-injection pump  
BMW 524 td





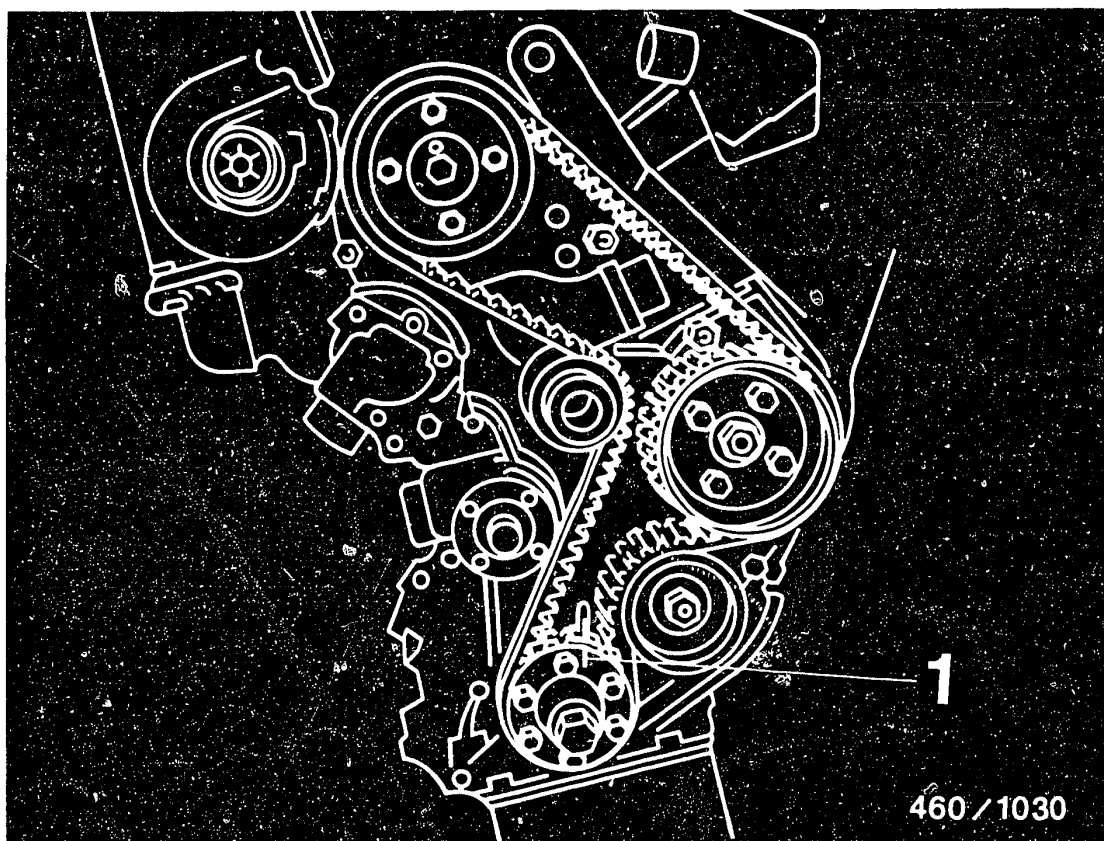
Note:

In the case of a new toothed belt, place a 2.5 mm feeler gauge (arrow) between the sealing surface for the cylinder head cover and the locking device KDEP 1136 on the outlet side.

**H11**

Install fuel-injection pump  
BMW 524 td





460 / 1030

Put the V-belt pulley on the vibration damper hub (1) of the crankshaft and tighten it to 22...24 Nm.

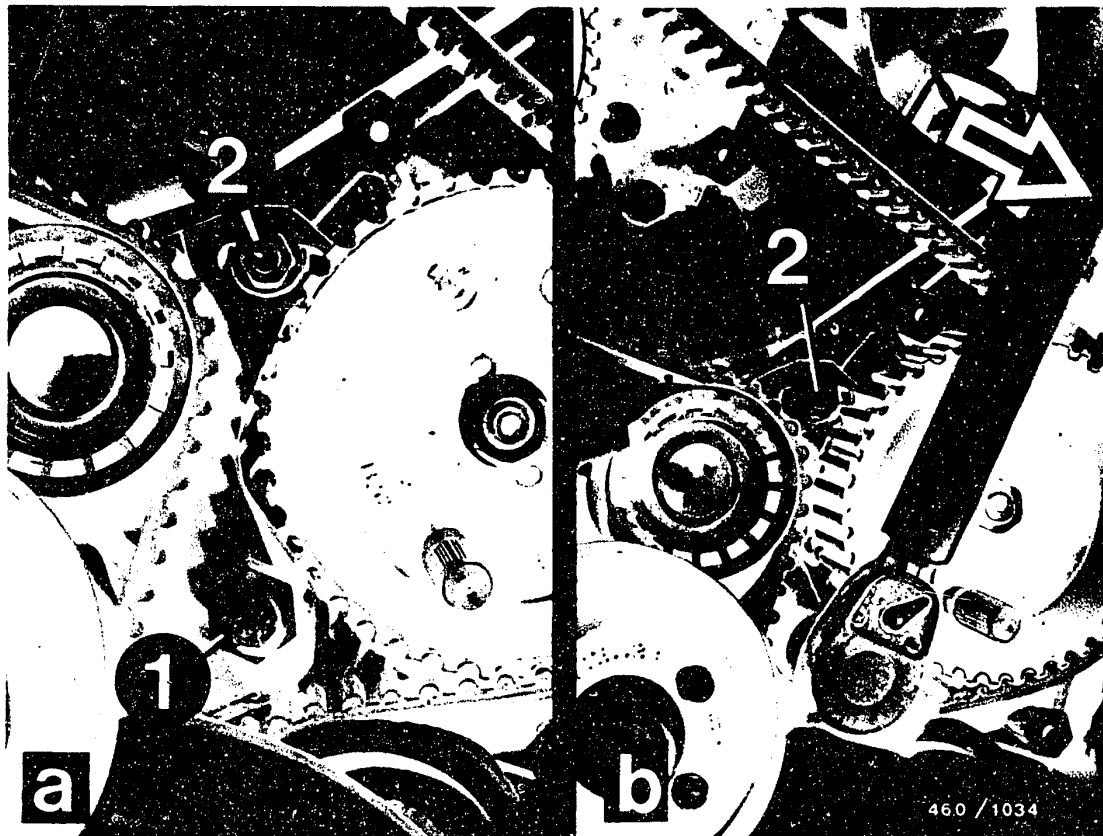
**H12**

Install fuel-injection pump

BMW 524 td







1 = Tensioning point

2 = Upper fastening nut

Remove setting mandrel (KDEP 1138) from injection pump gear.

Caution:

Toothed belt must not jump.

Pivot the tensioning roller against the back of the toothed-belt with 45...50 Nm at the clamping point (1) and tension the toothed-belt.

Tighten the fastening nut at the top (2) to 20...24 Nm.

Note:

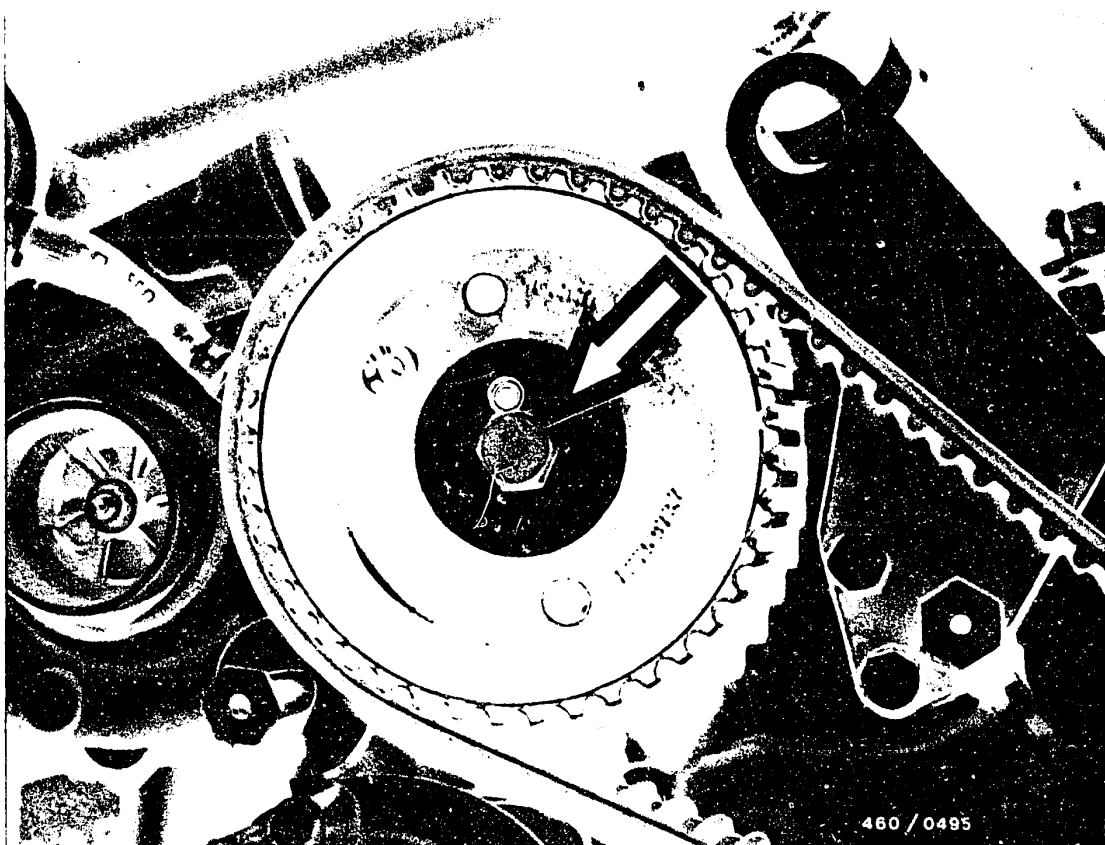
Use only torque wrench with pointer (adjustable wrenches are not suitable).

Remove the torque wrench and tighten the fastening screw at the bottom (1) to 20...24 Nm.

**H13**

Install fuel-injection pump  
BMW 524 td





Tighten camshaft gear to specified torque 65...70 Nm (arrow).

Remove locking device KDEP 1136 from camshaft and remove setting mandrel KDEP 1139 from flywheel.

Lay V-belt on alternator and tension.

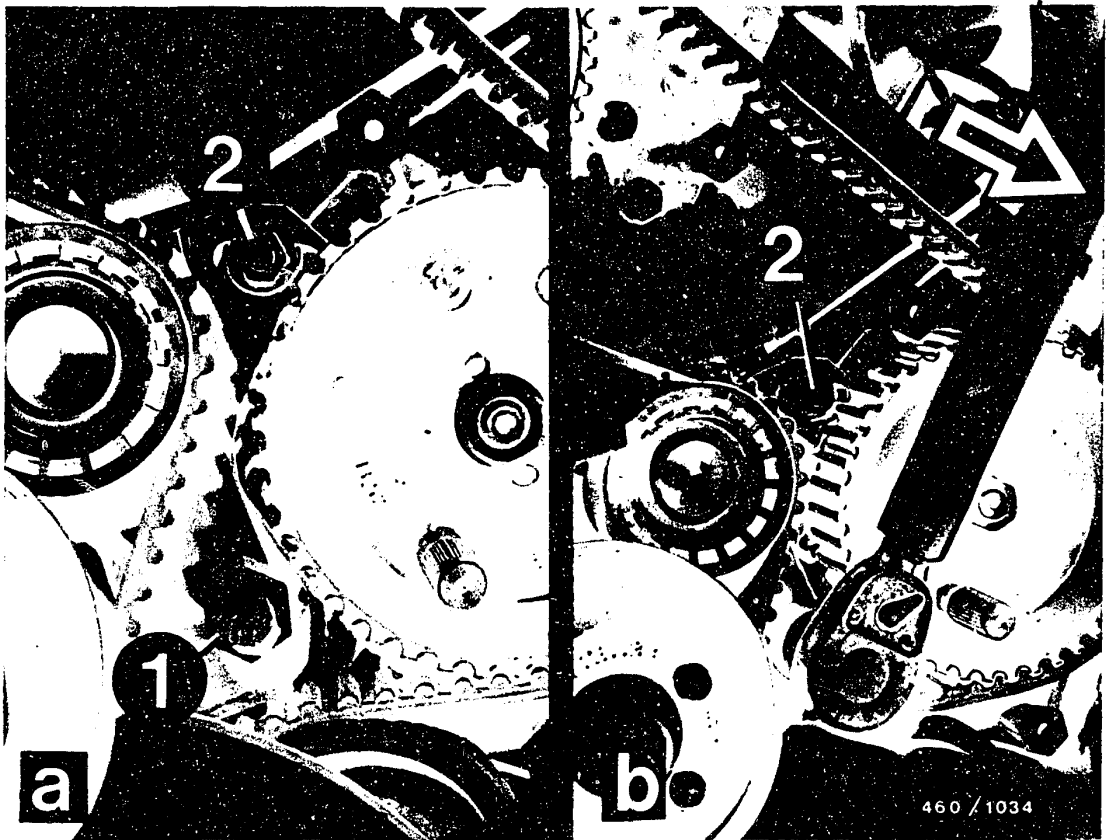
Section on changing the "toothed belt" completed.  
Continue installation on Coordinate H17.

**H14**

Install fuel-injection pump

BMW 524 td





1 = Clamping point

2 = Top fastening nut

Remove setting mandrel KDEP 1138 on the fuel-injection pump gear.

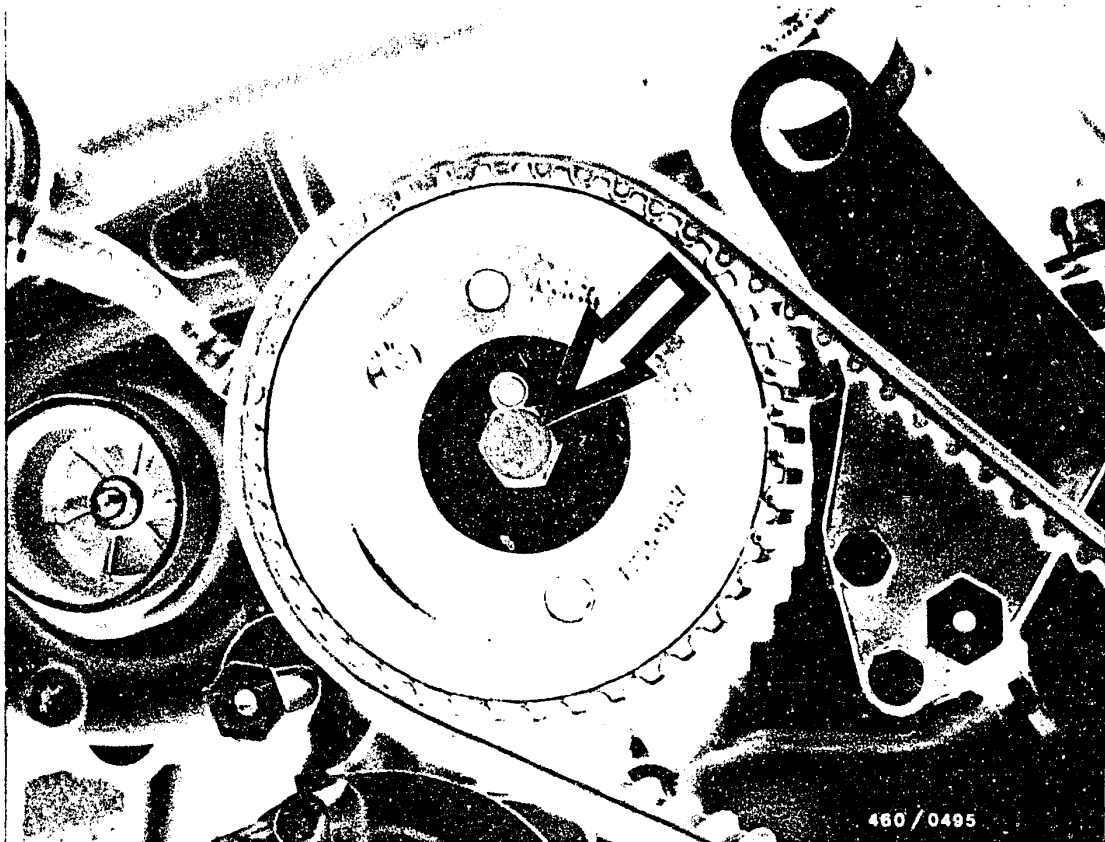
Swing tensioning roller with 45...50 Nm (toothed belt having been used for over 16 000 km (10 000 miles) 30...35 Nm) at tensioning point against the back of the toothed belt (arrow) and tension toothed belt.

Tighten the top fastening nut to 20 ... 24 Nm.

Note:

Use only torque wrenches with needles. (Adjustable wrenches are not suitable.)

Remove the torque wrench and tighten the bottom fastening screw (1) to 20...24 Nm.



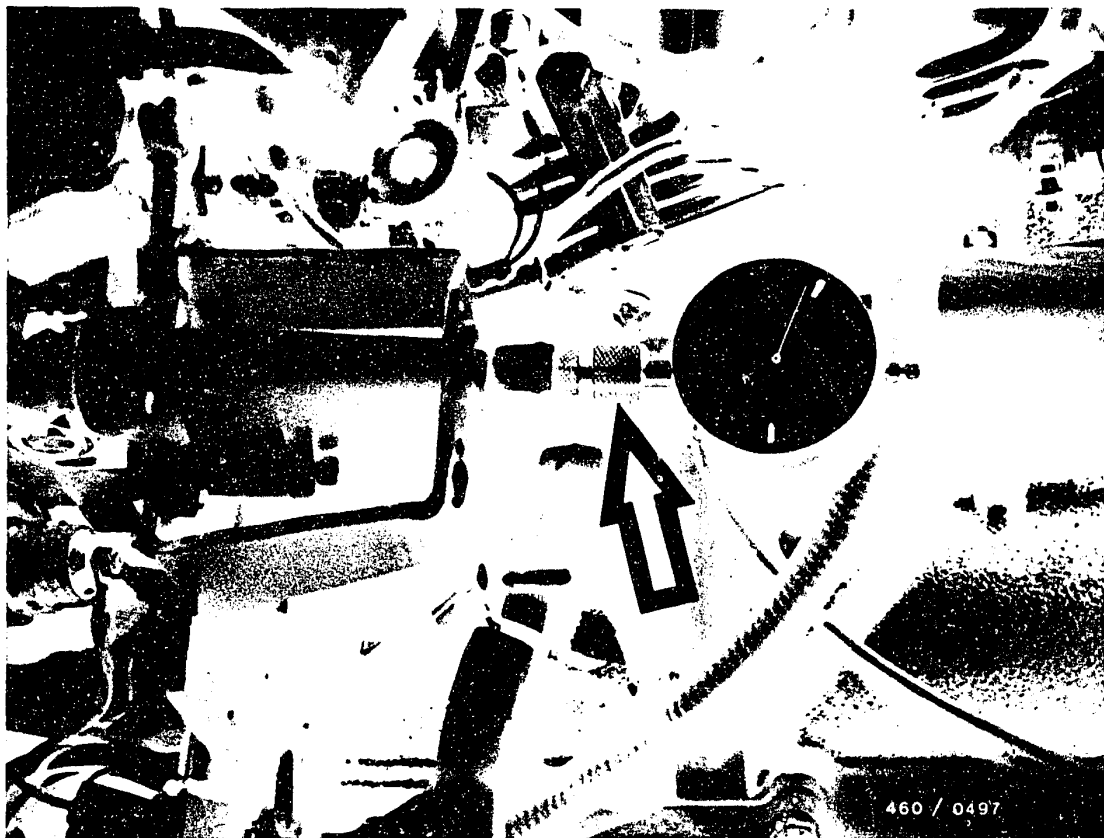
Tighten camshaft gear to specified torque 65...70 Nm (arrow).

Remove locking device KDEP 1136 from camshaft and remove setting mandrel KDEP 1139 from flywheel.

**H16**

Install fuel-injection pump  
BMW 524 td





Unscrew bleeder screw out of central screw plug (triangular plug) of hydraulic head.

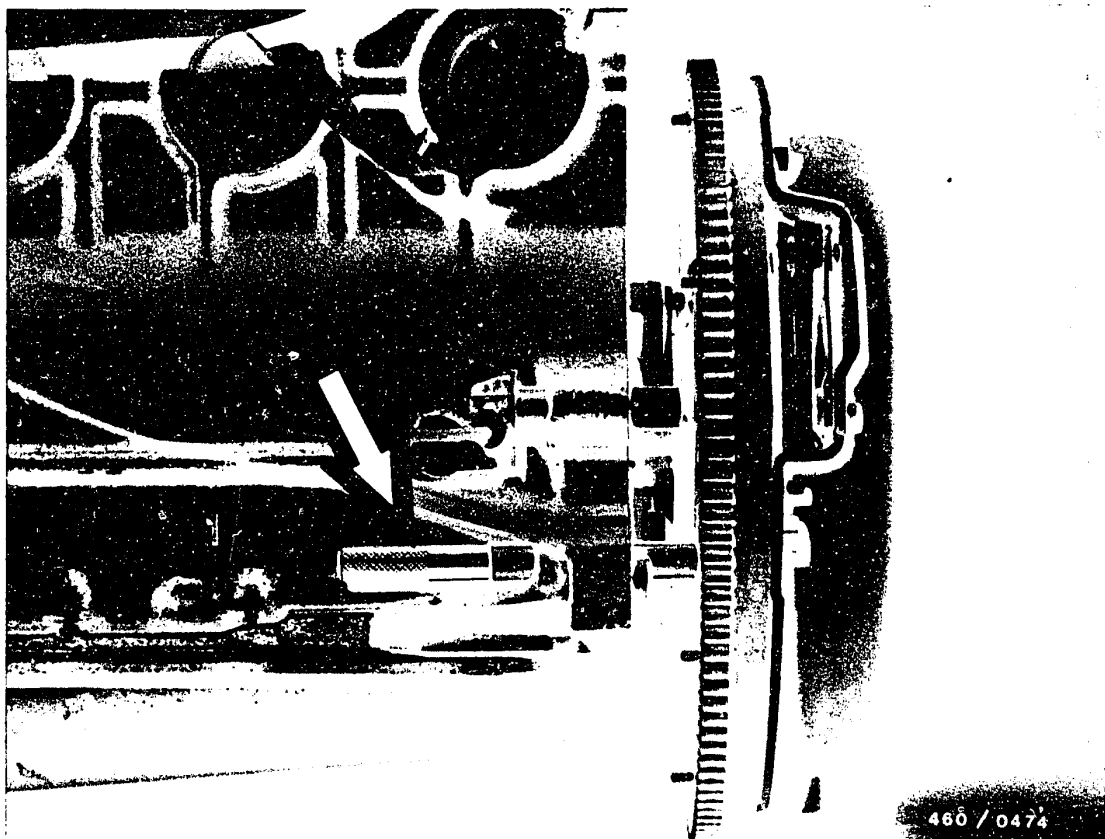
Screw measuring tool KDEP 1085 (arrow) into tapped hole in bleeder screw.

Mount mini dial indicator with measuring insert in measuring tool KDEP 1085.

**H17**

Install fuel-injection pump  
BMW 524 td





Preload dial indicator by approx. 2.5 mm.

Turn crankshaft slowly against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

Turn crankshaft in engine direction of rotation until cylinder 1 is at TDC.

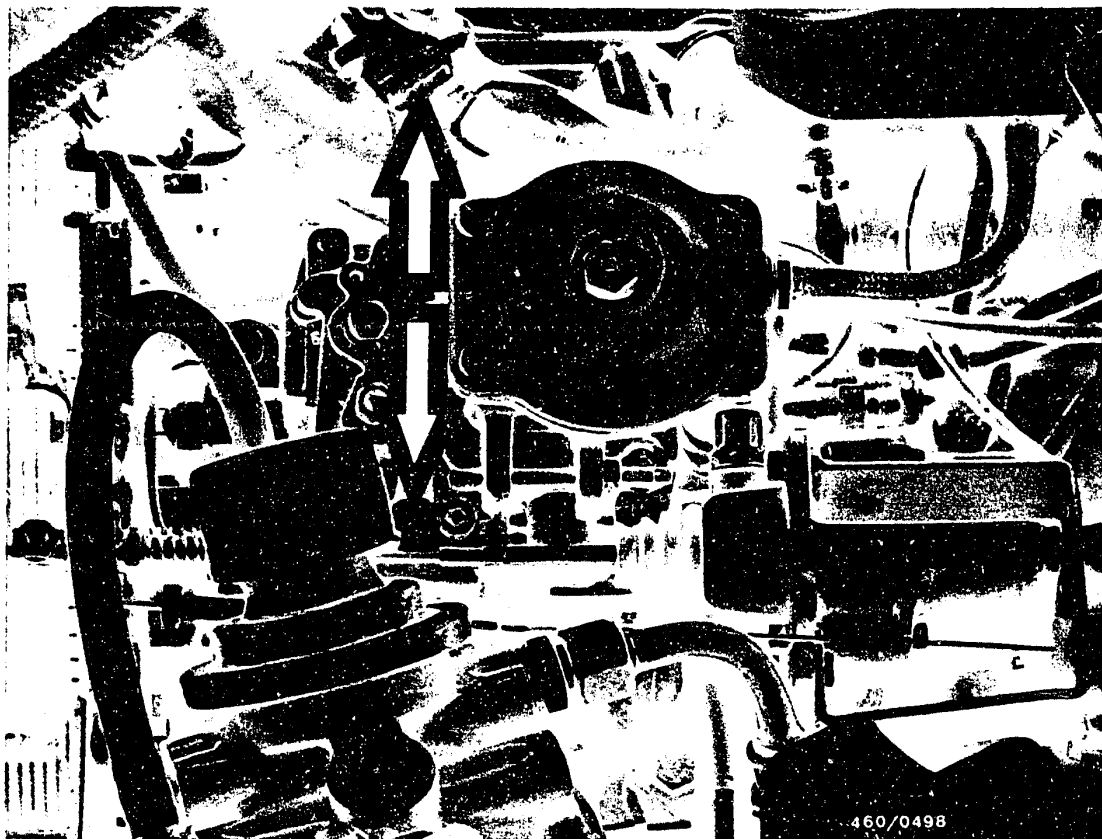
Fix the flywheel in place using setting mandrel KDEP 1139 (arrow).

**H18**

Install fuel-injection pump

BMW 524 td





In this position, the dial indicator must indicate a stroke of:

0.65 mm ABDC (setting value)

0.61...0.69 mm ABDC (checking value).

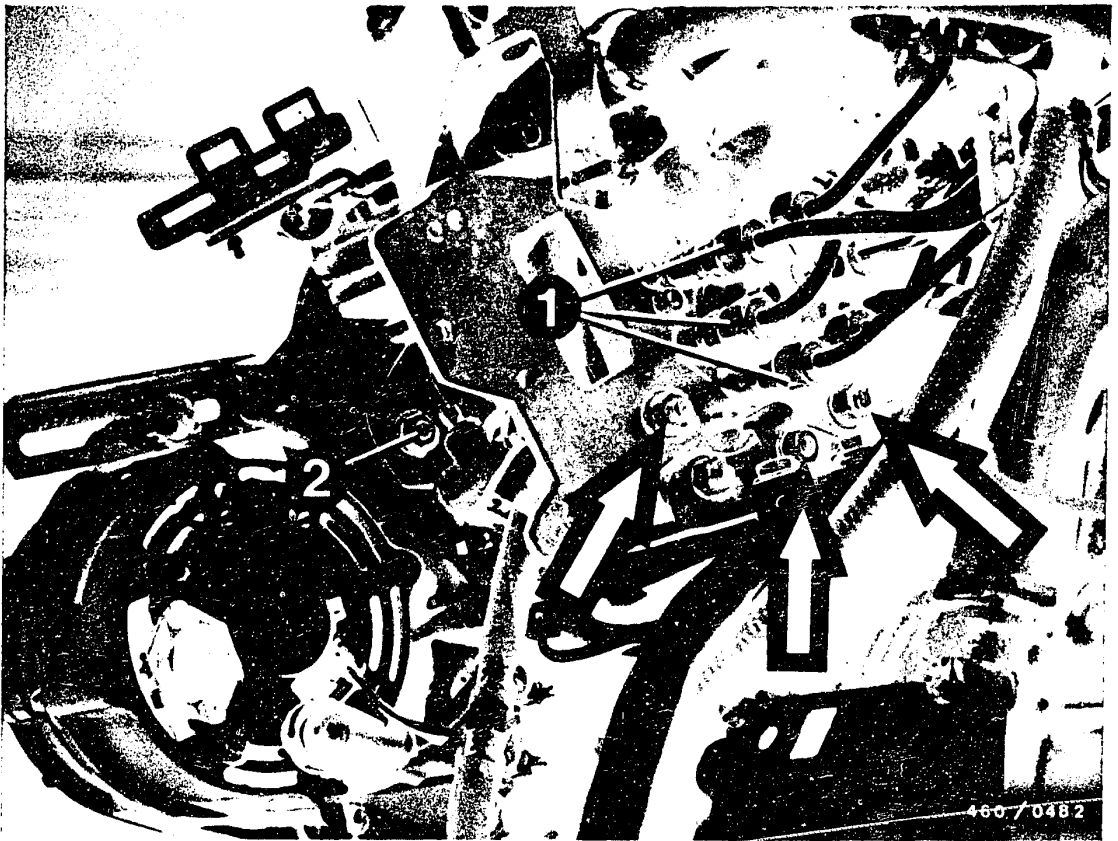
If a correction is necessary, loosen injection pump fastening screws.

Pivot injection pump until a stroke of 0.65 mm is obtained.

If the reading is too small, pivot pump toward engine.

If reading is too great, pivot pump away from engine.





1 = Delivery-valve holder      2 = Fastening screws

Tighten fastening screws of injection pump to 25 Nm.

Remove setting mandrel KDEP 1139.

Turn crankshaft over twice and check setting.

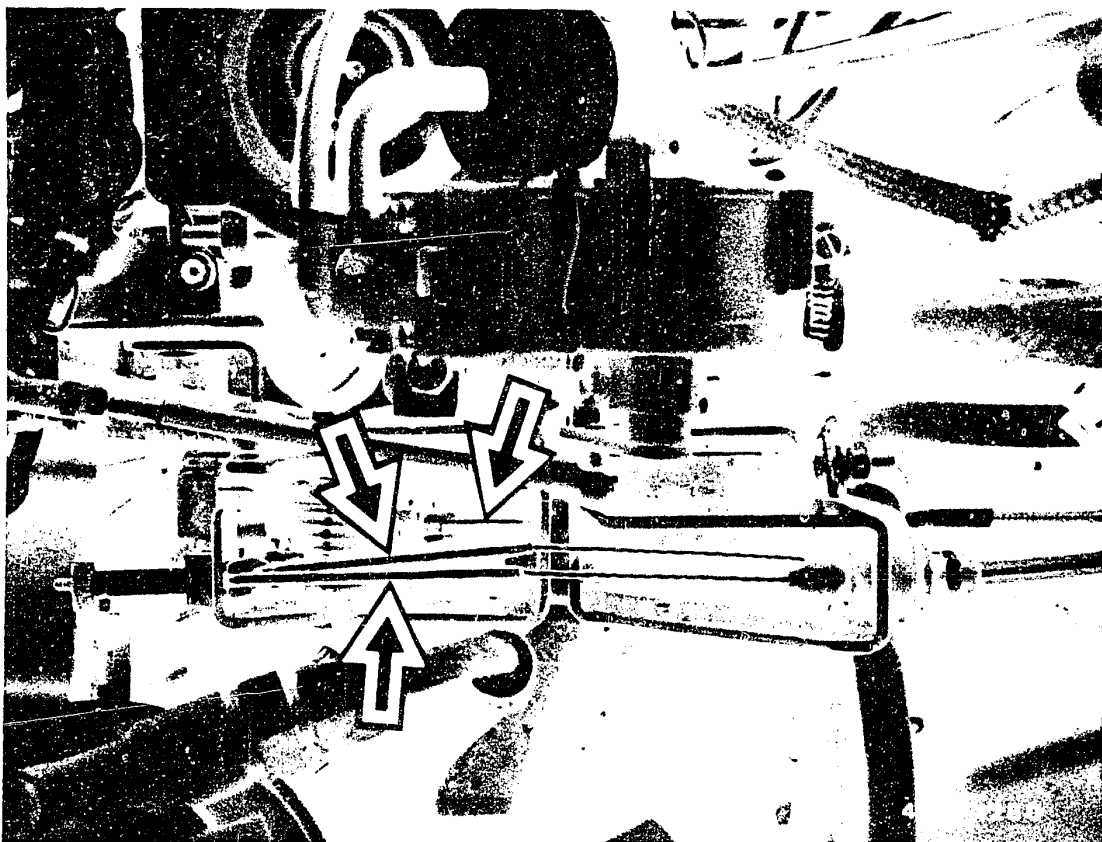
Remove measuring tool KDEP 1085 with dial indicator.

Mount bleeder screw with new seal ring.

Screw down injection pump support bracket with  
20...24 Nm (arrows).

Tighten injection lines with open box wrench KDEP 1115,  
while preventing the delivery-valve holders from turning  
by holding with a wrench.



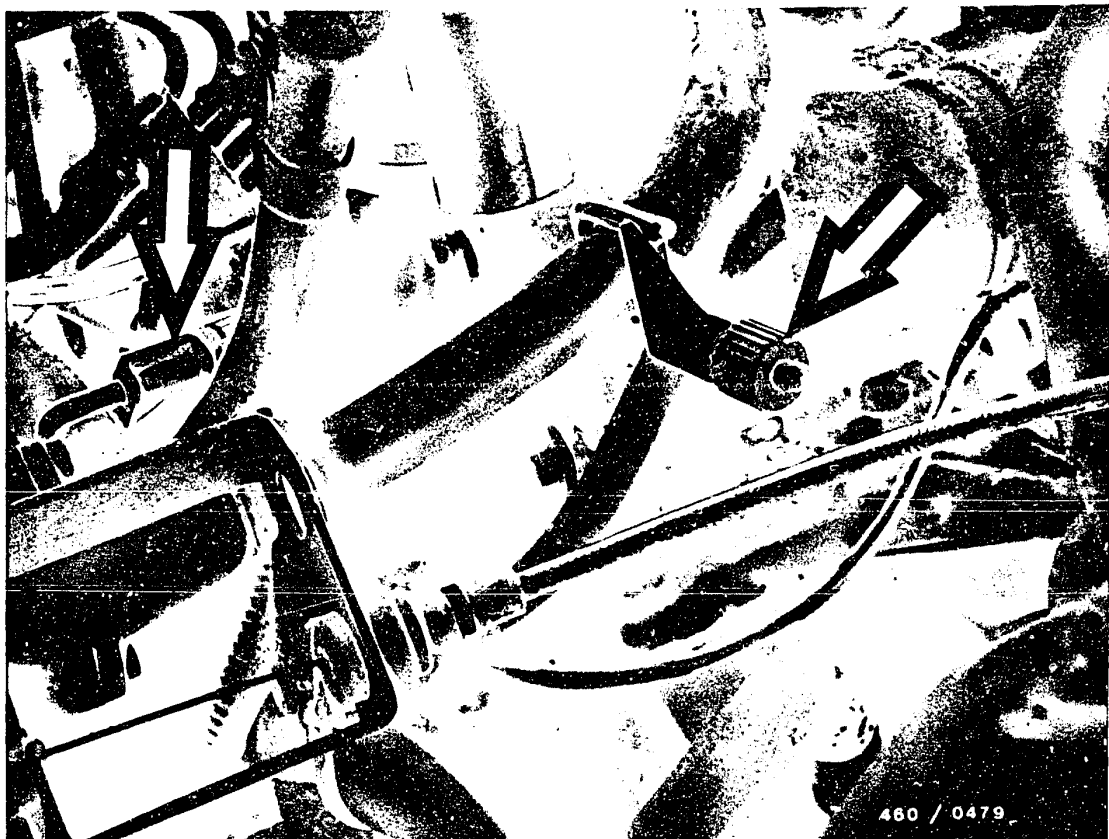


Put in and adjust the cables (arrows).

**H21**

Install fuel-injection pump  
BMW 524 td





Connect coolant lines to control devices of injection pump.

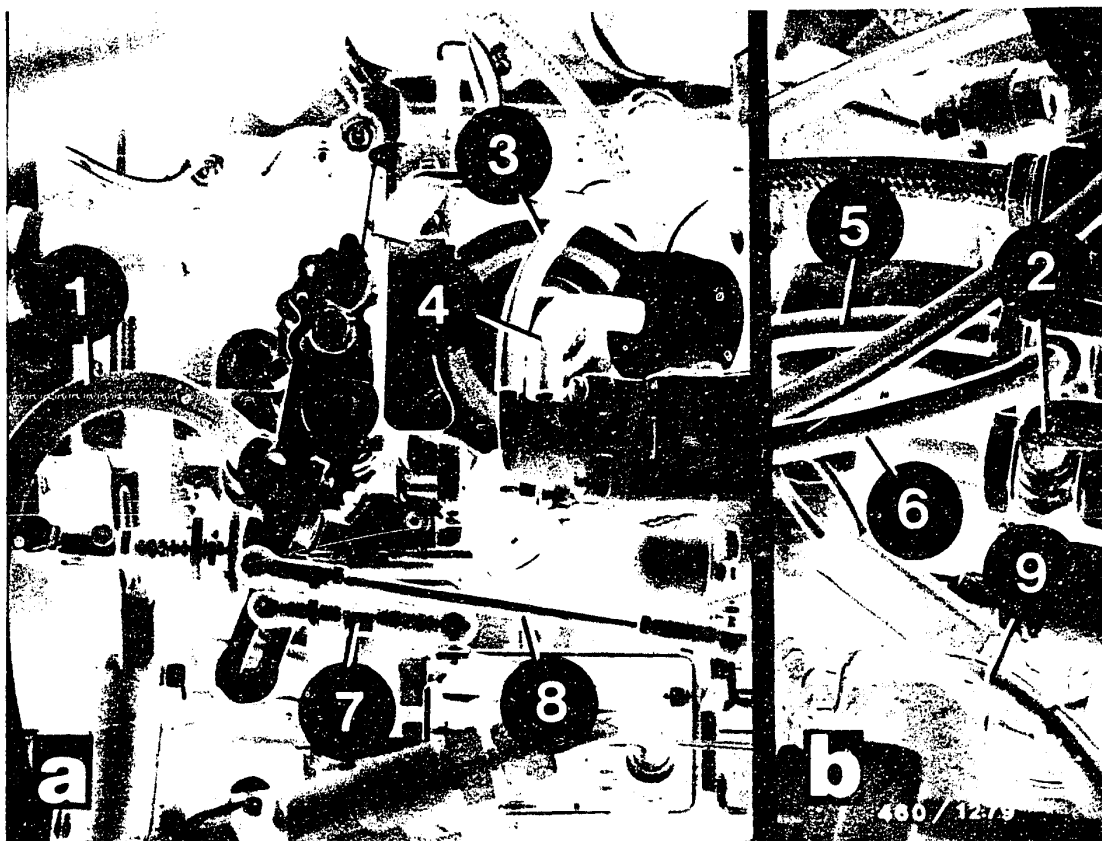
Tighten hose clip.

Remove hose clampers (arrows).

**H22**

Install fuel-injection pump  
BMW 524 td





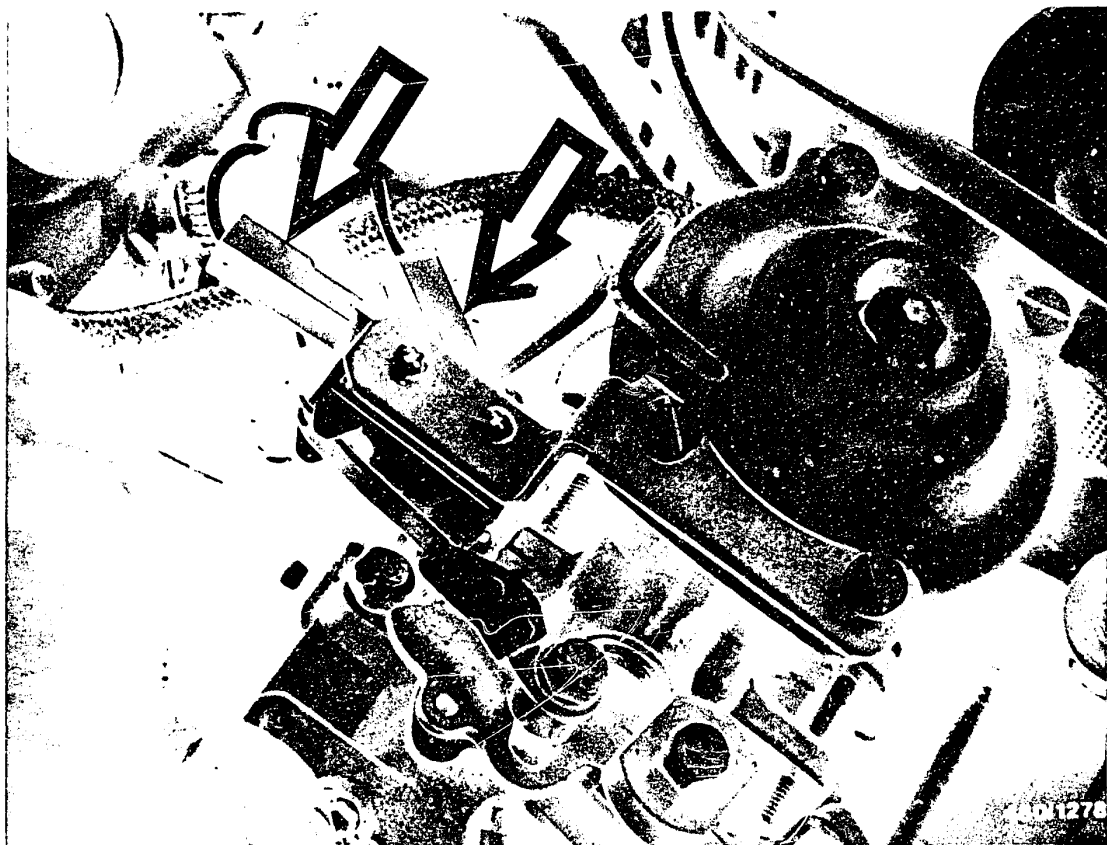
Mount fuel inlet line (1), return line (2), vacuum hoses (3), (4), (5) and (6), connecting rods (7) and (8) and cable for electrical shutoff device (9).

Note:

Do not mix up the inlet-union screws of the fuel inlet and return lines.

The hollow screw for the return is provided with restriction bores and the head of the screw is marked "out".



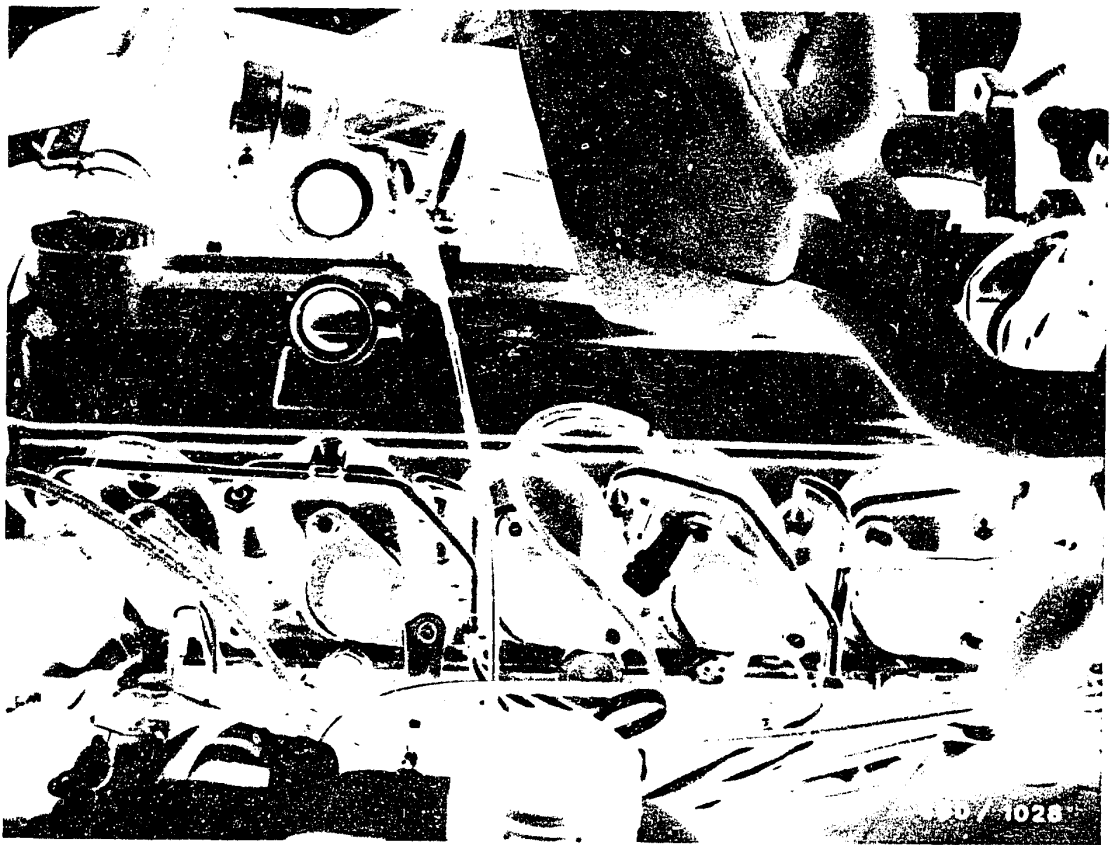


Connect connector on microswitch (arrows).

**H24**

Install fuel-injection pump  
BMW 524 td



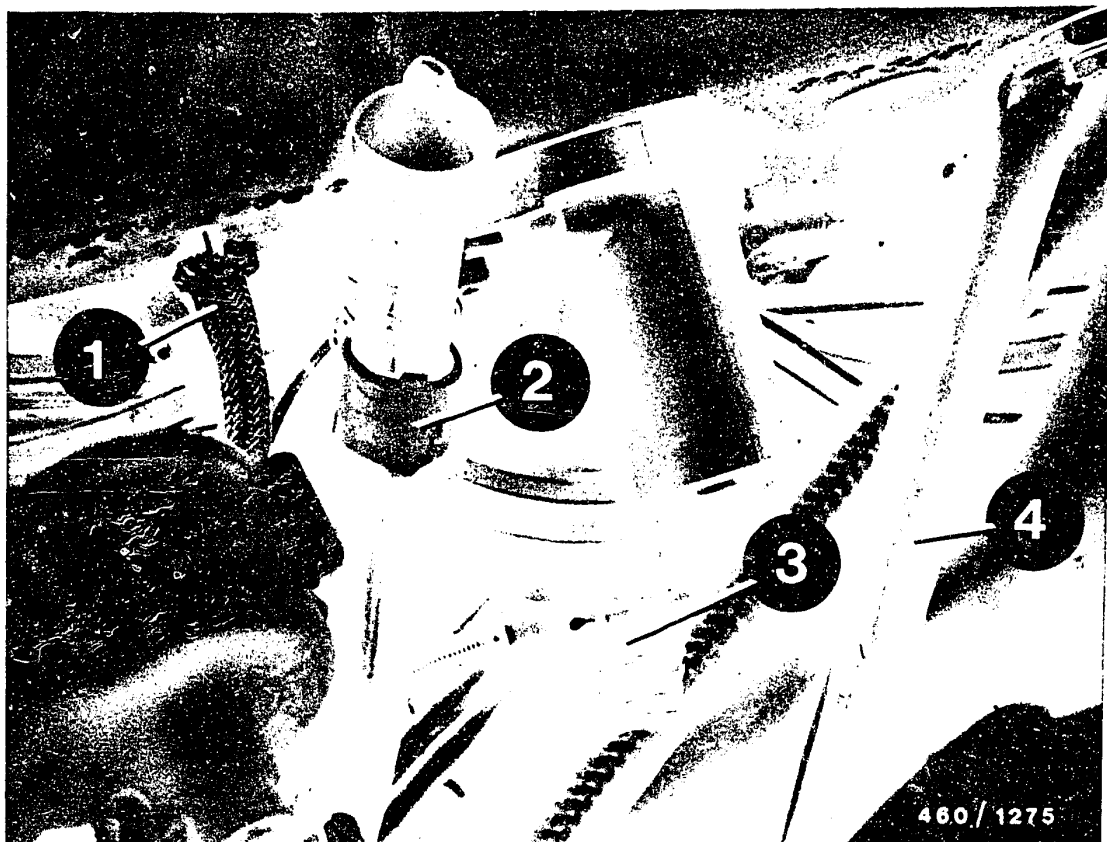


Mount charge-air pipe with new intake gaskets.

**J1**

Install fuel-injection pump  
BMW 524 td





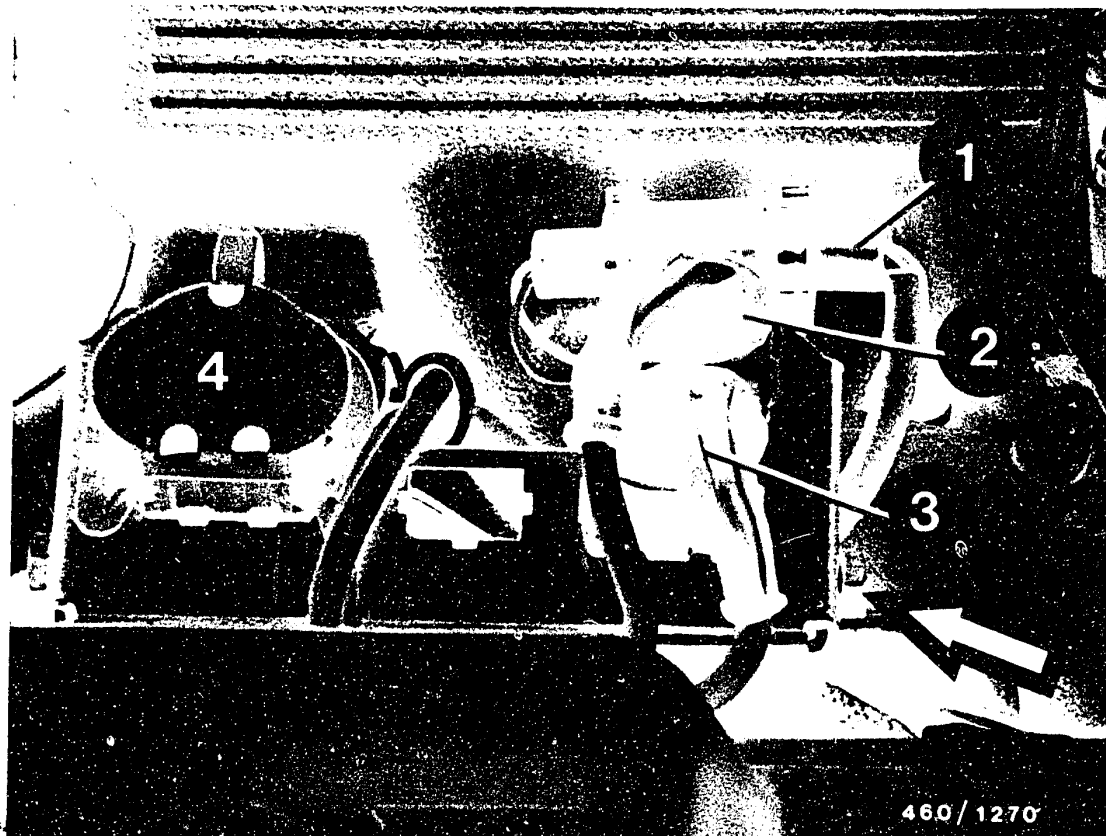
Remove hose line to ALDA \* (1), fastening clamp for oil dipstick (2), connector on blow-off valve (3) and support bracket for charge-air pipe (4).

\* ALDA = Altitude- and manifold-pressure compensator

**J2**

Install fuel-injection pump  
BMW 524 td





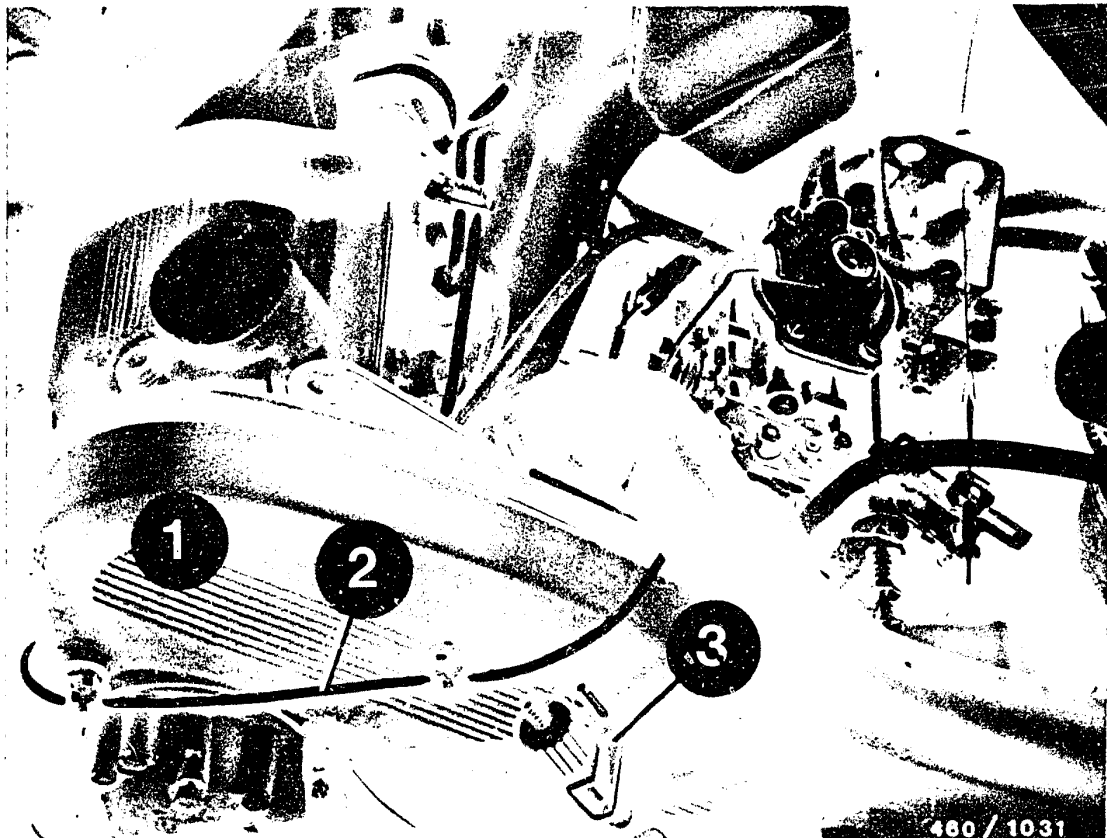
Screw plug board onto bracket (arrow).

Mount plug connector halves for timing valve (1), start of injection (2), tachometer (3) and diagnostic plug (4) in plug board and connect mating halves.

**J3**

Install fuel-injection pump  
BMW 524 td





Mount toothed-belt cover (1) and wiring harness (2).

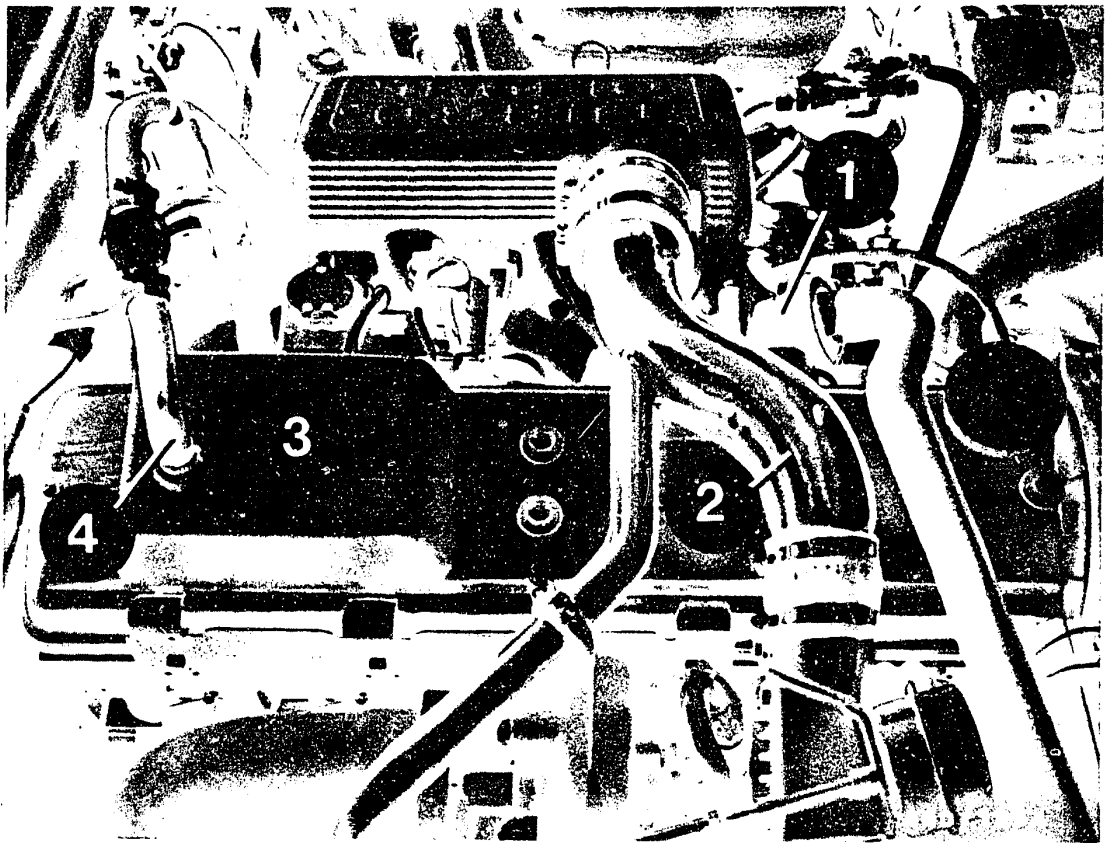
Mount cooling water hose on water pump and remove hose clamber (3).

**J4**

Install fuel-injection pump  
BMW 524 td





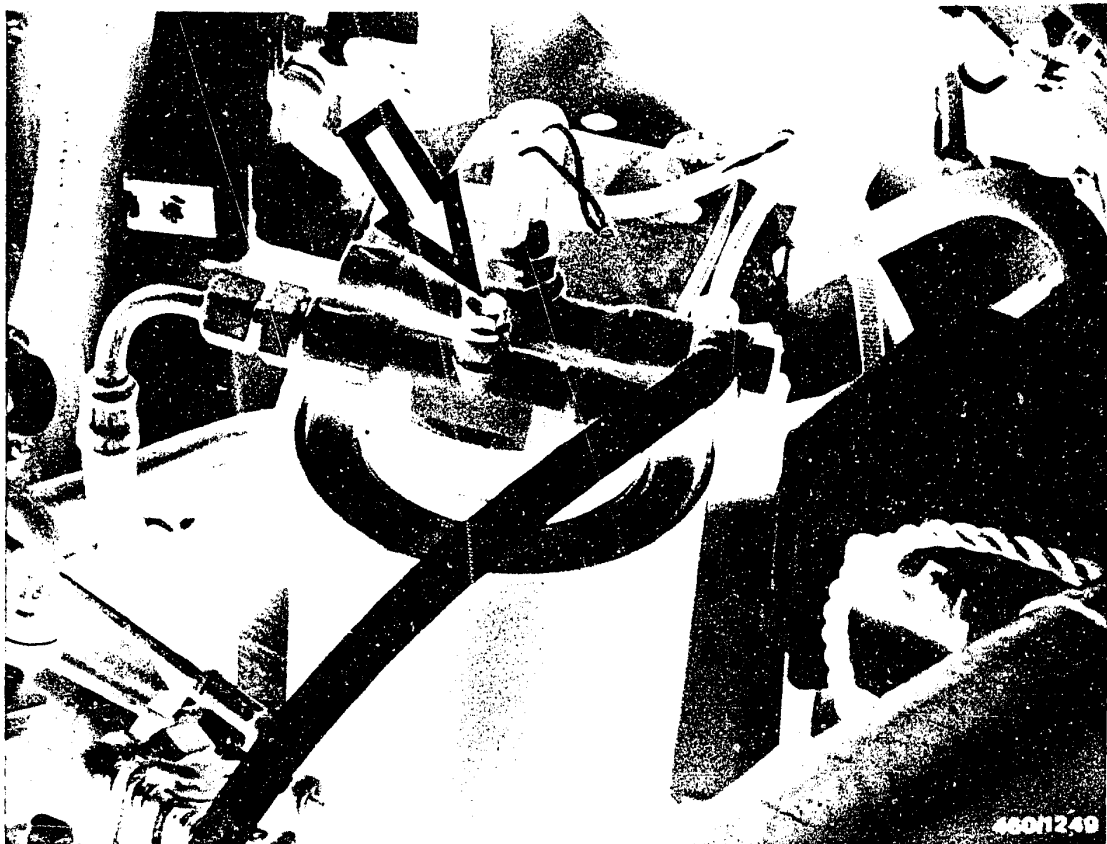


Mount crankcase ventilation pipe (1), connecting pipe between turbocharger and charge-air pipe (2) as well as cylinder head cover (3).

Connect vacuum hose to vacuum pump (4).

Connect negative cable to battery.





### Bleeding the fuel system

Bring glow-plug and starter switch to "engine operation" position.

Loosen bleeder screw on fuel filter (arrow).

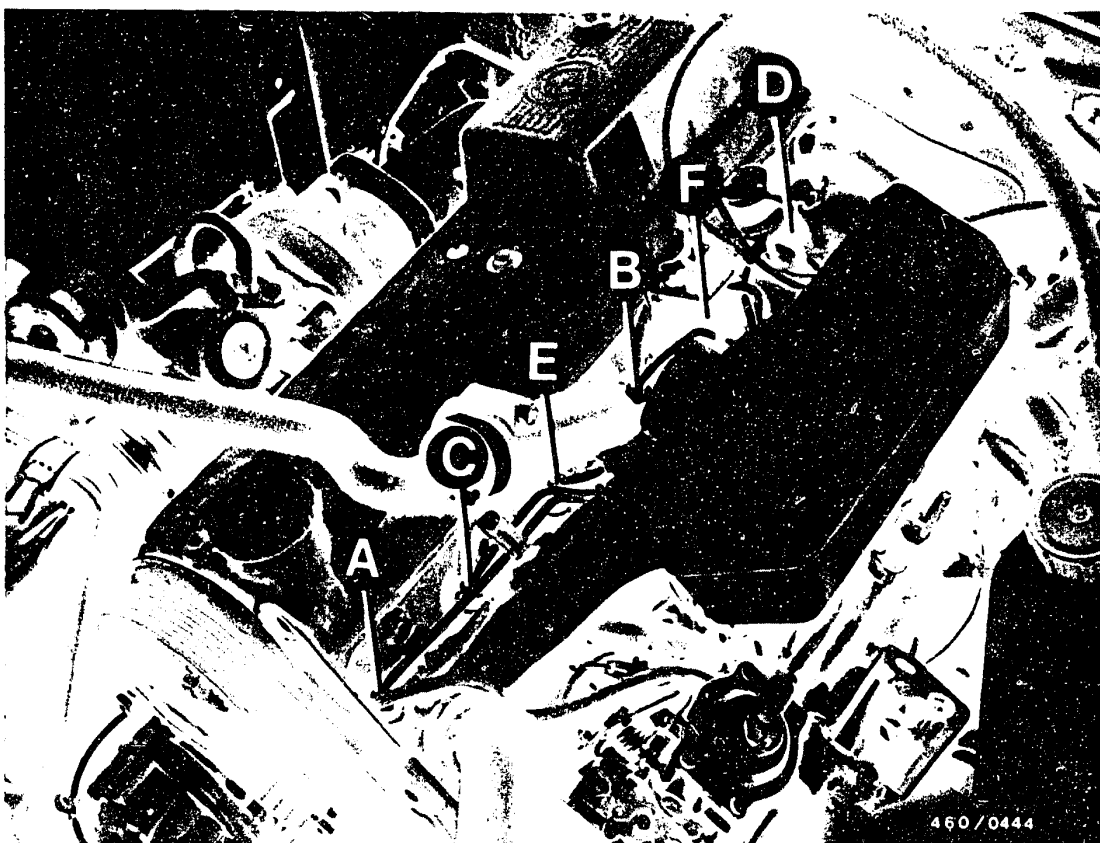
Let fuel supply pump operate until fuel escaping from bleeder screw is free of bubbles.

Tighten bleeder screw.

**J6**

Install fuel-injection pump  
BMW 524 td





Loosen union nuts of fuel-injection tubing (A...F) on injection-nozzle holders.

Operate engine starting motor until fuel escapes from union nuts of injection-nozzle holders.

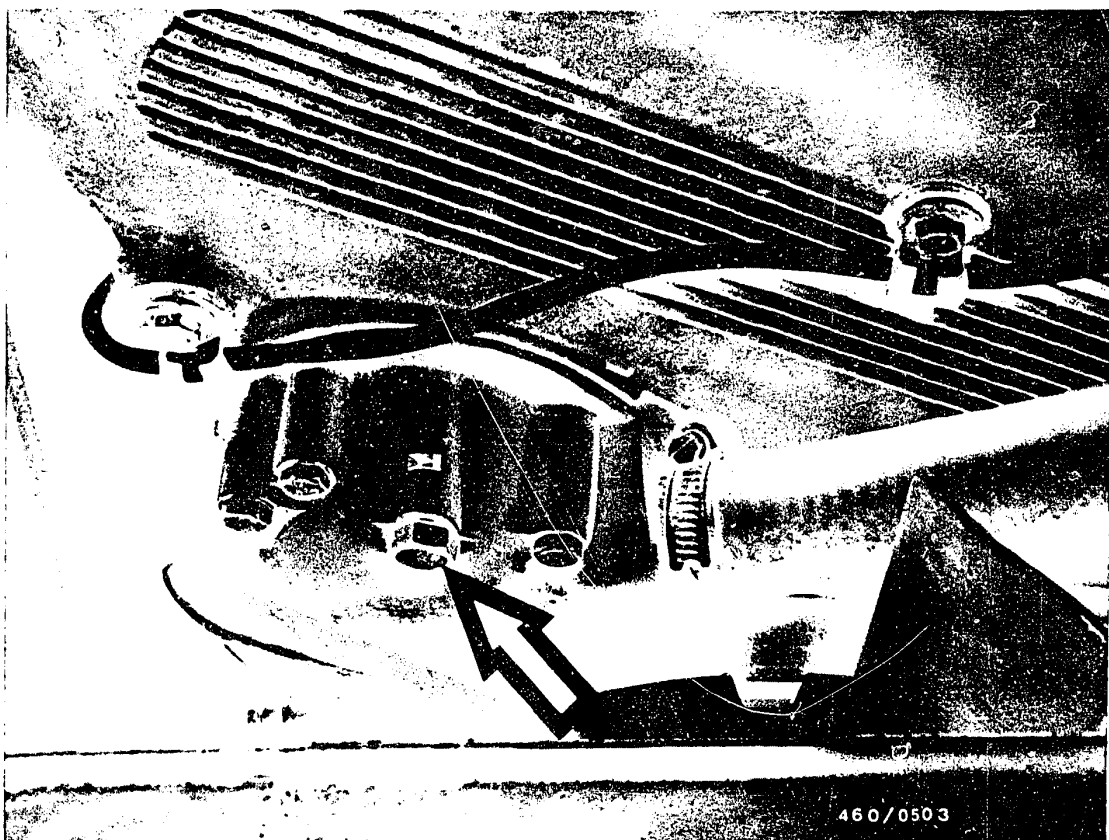
Tighten union nuts.

Operate starting motor until engine starts.

**J7**

Install fuel-injection pump  
BMW 524 td





### 35.1 Bleeding cooling system

Fill in coolant up to mark on expansion tank.

Close expansion tank.

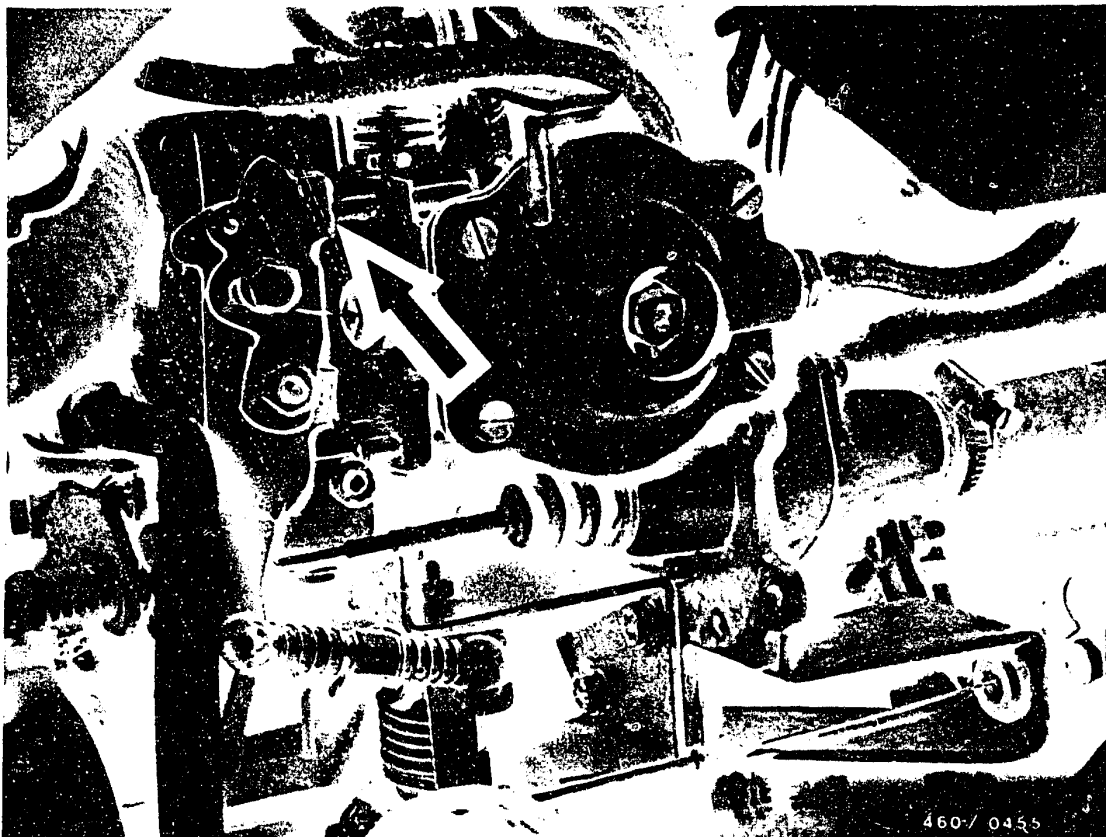
Fully open heating control.

Run engine until operating temperature is reached.

Loosen bleeder screw (arrow) on water pump until coolant escapes.

Tighten bleeder screw.





35.2 Adjust idle speed (on vehicles with manual and automatic transmissions)

Connect a tachometer (e.g., photoelectric) to the engine. To do so, put reflection mark on the crankshaft. Aim digital manual tachometer at reflecting mark and start engine and run at idle speed.

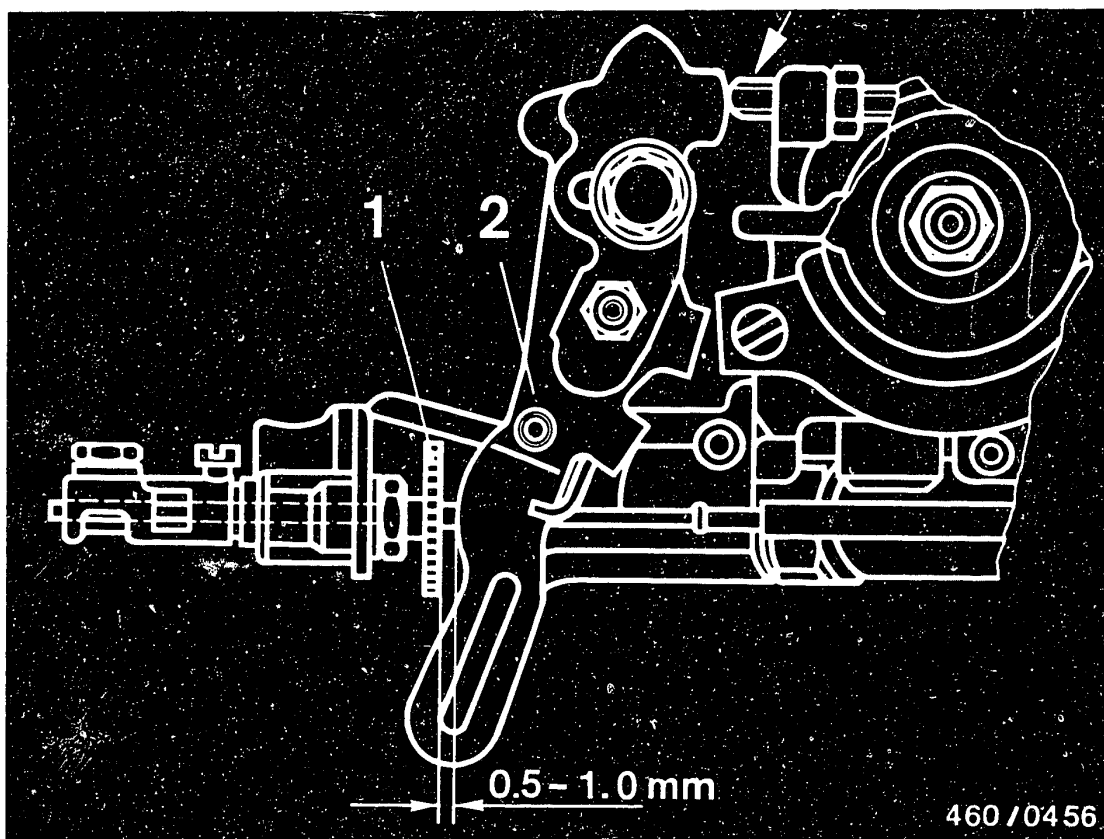
C a u t i o n:

For adjusting the idle speed, the engine must be at normal operating temperature (engine temperature  $> +60^{\circ}\text{C}$ ).

The temperature-controlled idle-speed increase must be switched off.

The control lever is up against the idle-adjusting screw (arrow).





1 = Knurled thumbscrew

2 = Control lever

Adjust engine speed at the idle-adjusting screw (arrow) to  $750 \pm 50 \text{ min}^{-1}$ .

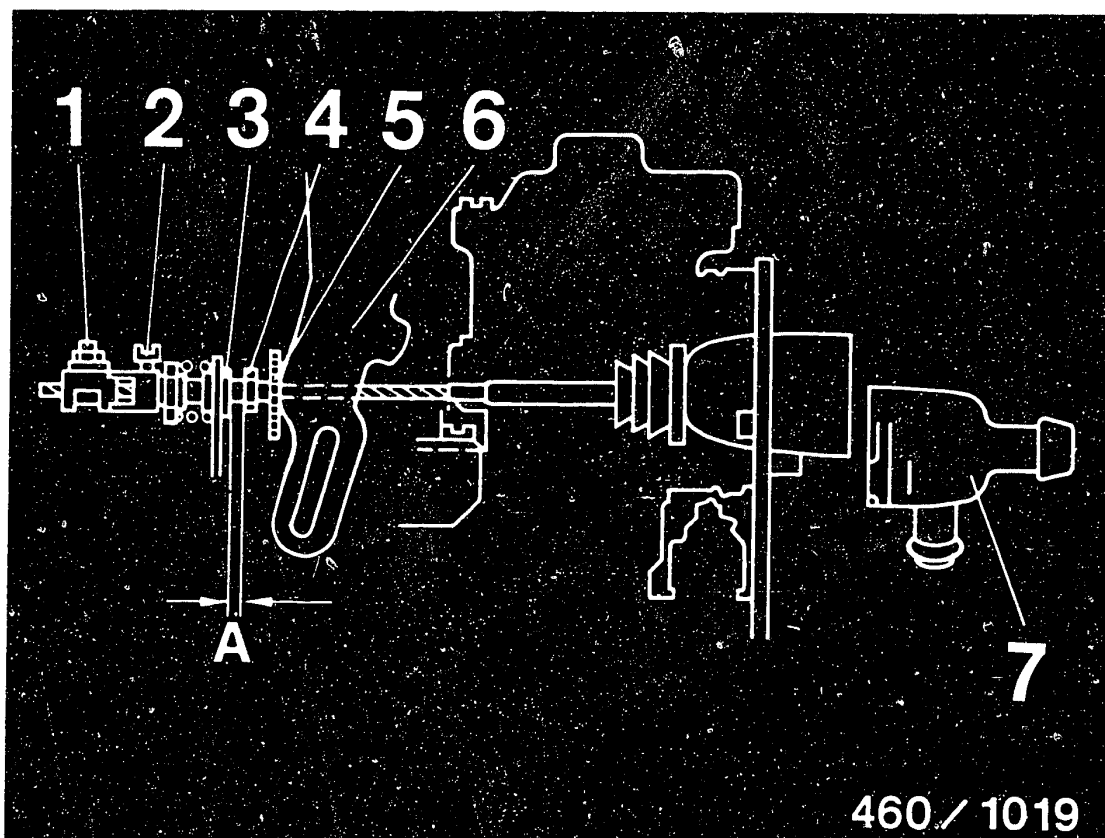
Turn the knurled thumbscrew until there is a clearance of from 0.5 - 1.0 mm between the control lever and the knurled thumbscrew.

Note:

The engine camshaft and fuel-injection pump are driven at half the engine speed.

After adjusting, lock the adjusting screw and seal it.

After adjusting the idle speed, check cable for accelerator and engine-speed control lever position (only on vehicle with automatic transmission) and adjust if necessary.



460 / 1019

### 35.3 Adjusting the idle-speed increase

#### Testing the total travel

Remove the housing of the temperature-controlled idle-speed increase device (7).

Measure distance "A" between the lock nut for the knurled thumbscrew (4) and the band of the holding bracket (3).

Specified value: 5.1 ... 5.9 mm

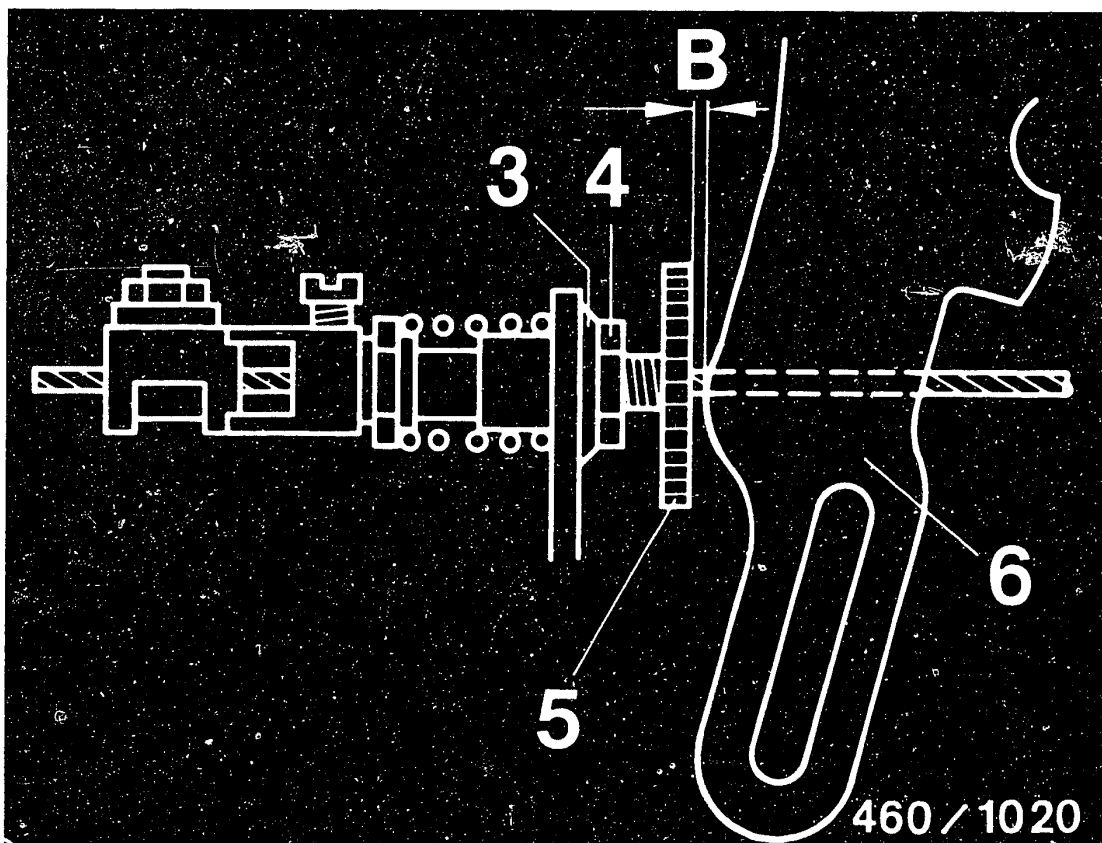
For measurement, the control lever (6) must lie up against the knurled thumbscrew (5).

#### Adjustment:

Release the clamping piece (1 and 2) and shove far enough so that dimension "A" is within the range of tolerances.

First fasten clamping piece (1), then clamping piece (2).

Put the housing (7) back on.



Check the distance from the control lever to the  
knurled thumbscrew (adjust)  
Adjustment with engine warm

Pre-condition:

- Warm idle adjustment O.K.
- Coolant temperature > 25°C
- Lock nut (4) lies up against the band (3)
- The control lever (6) lies up against the idle adjusting screw

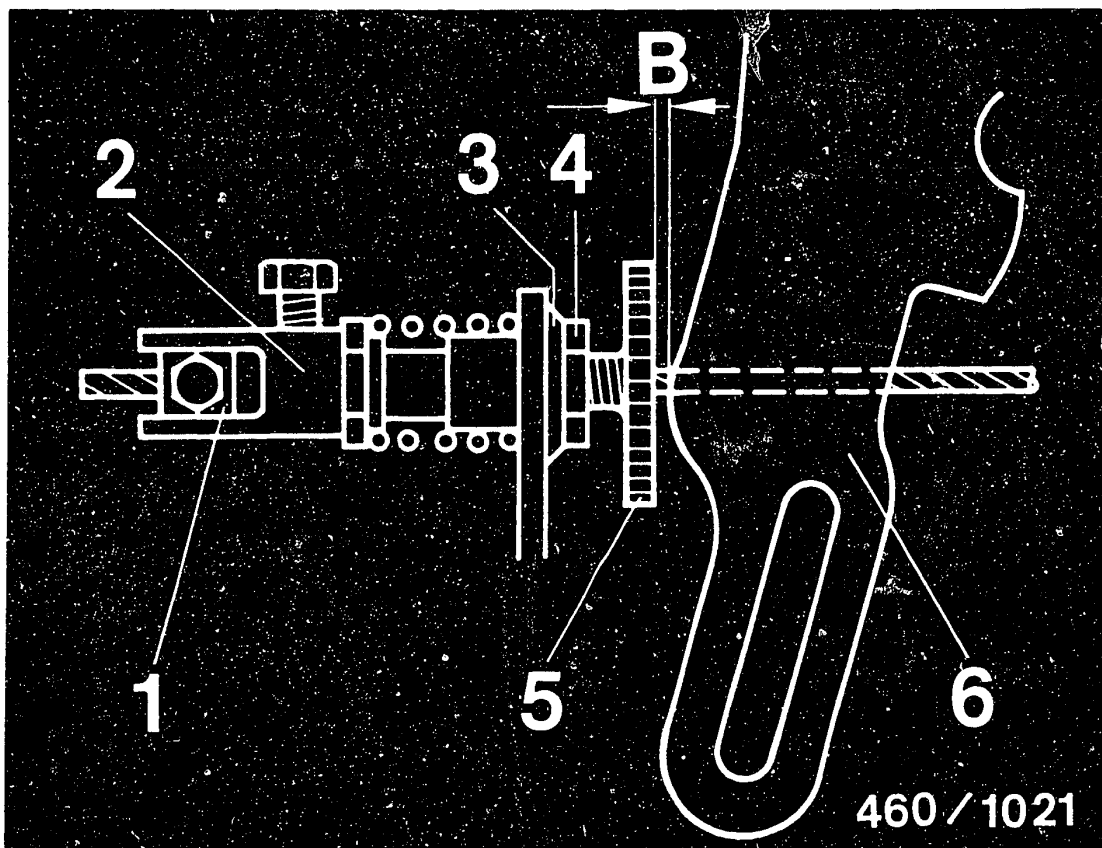
Measure distance "B" between the control lever (6) and the knurled thumbscrew (8).

Specified value: 0.2...0.8 mm

If the specified value is not attained, release the lock nut (4) and turn the knurled thumbscrew (5) until dimension "B" is within the range of tolerances.







Check distance from the control lever to the  
knurled thumbscrew (adjust)  
Adjustment with engine cold

Release clamping piece (2) and turn it by 90°.  
(Clamping piece (2) slides over clamping piece (1).)

Pre condition:

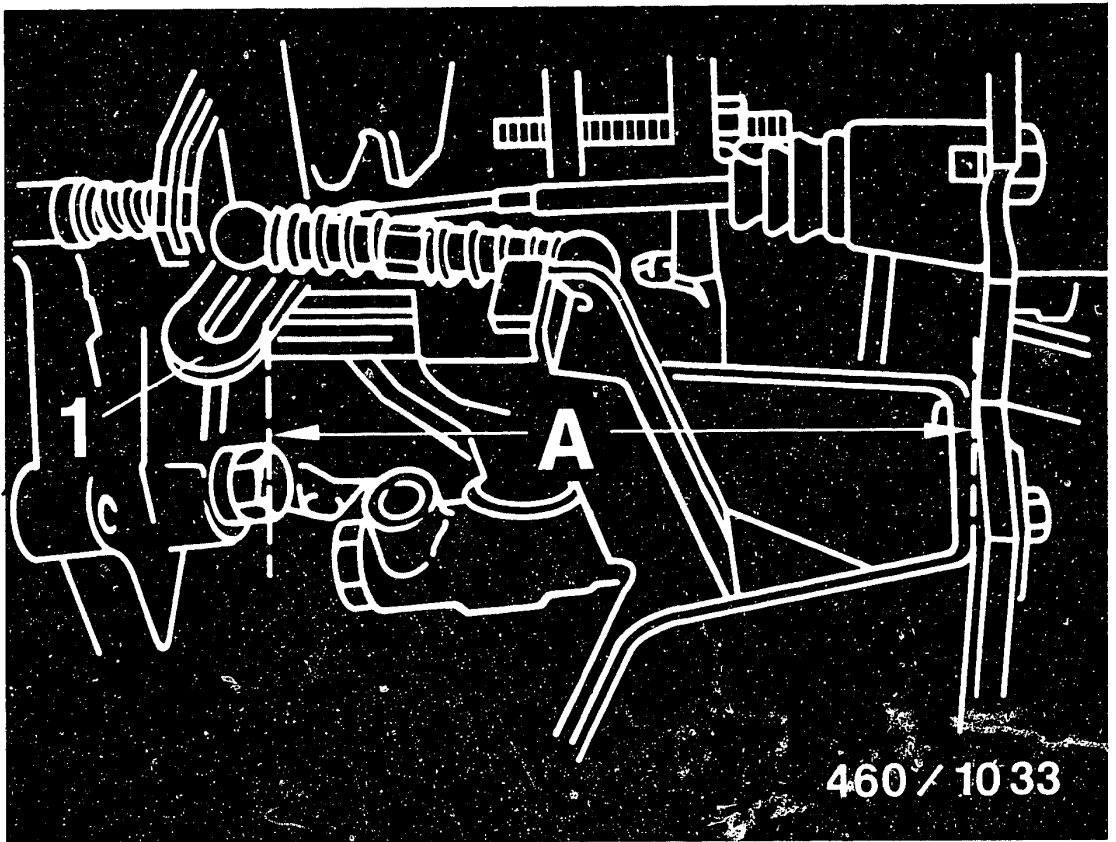
- Warm idle adjustment O.K.
- Lock nut (4) lies up against the band (3)
- Control lever (6) lies up against the idle-adjusting screw

Measure distance "B" between the control lever (6) and the knurled thumbscrew (5).

Specified value: 0.2 ... 0.8 mm.

If the specified value is not attained, release the lock nut (4) and turn the knurled screw (5) until dimension "B" is within the range of tolerances. Turn clamping piece (2) again by 90° and fasten it.





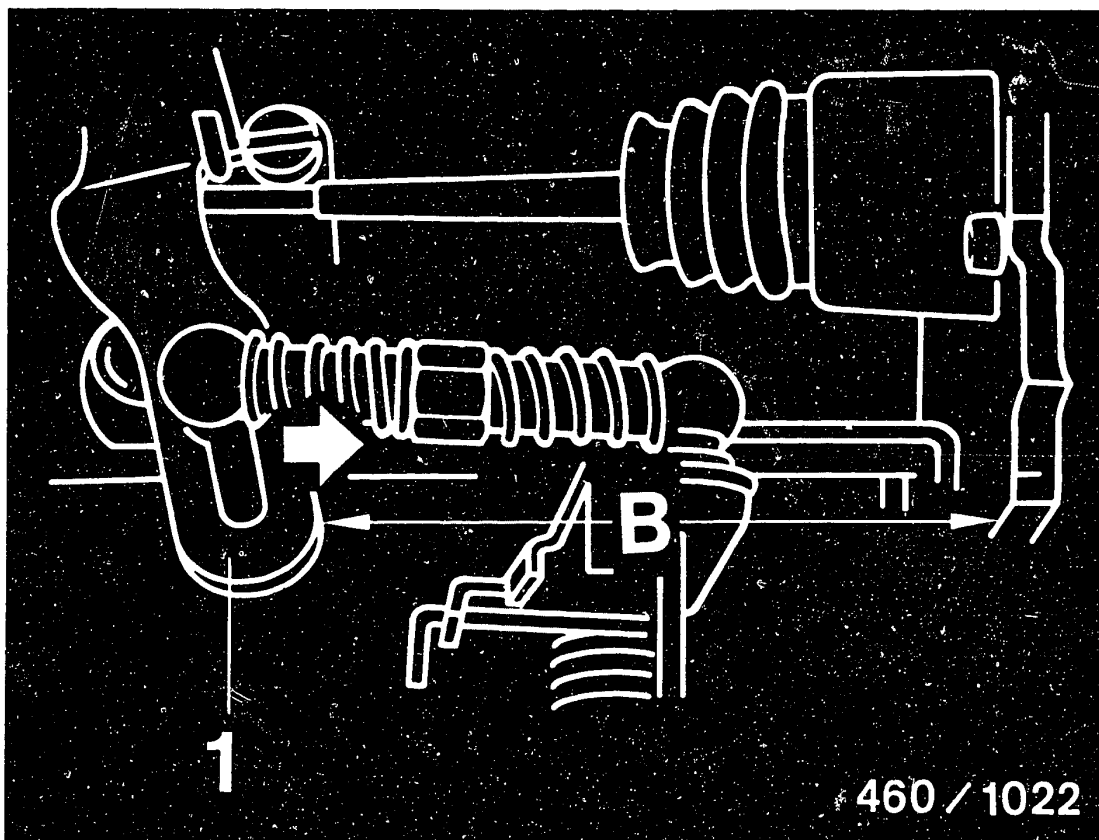
35.4 Adjust engine-speed control lever (for vehicle with automatic transmission)

Pre-condition:

- Idle speed adjusted
- Engine at normal operating temperature
- Control lever (1) lies up against the idle stop

Measure dimension "A" and note it down.





Press the control lever (1) against the full-load stop.  
Measure dimension "B" and note it down.

Subtract dimension "B" from dimension "A".

$$A - B = C$$

Example:

A = 98 mm

B = 47 mm

C = 51 mm

With the value C = 51 mm as calculated,  
dimension "D" is 61.1 mm, from the tab  
table.

Obtain dimension "D" for the adjustment linkage from  
the table below.

Adjustment table:

C (mm)	41	41.5	42	42.5	43	43.5	44	44.5
D (mm)	78.1	77.0	76.0	74.9	73.9	73.0	72.0	71.1

C (mm)	45	45.5	46	46.5	47	47.5	48	48.5
D (mm)	70.3	69.4	68.6	67.8	67.0	66.3	65.6	64.9

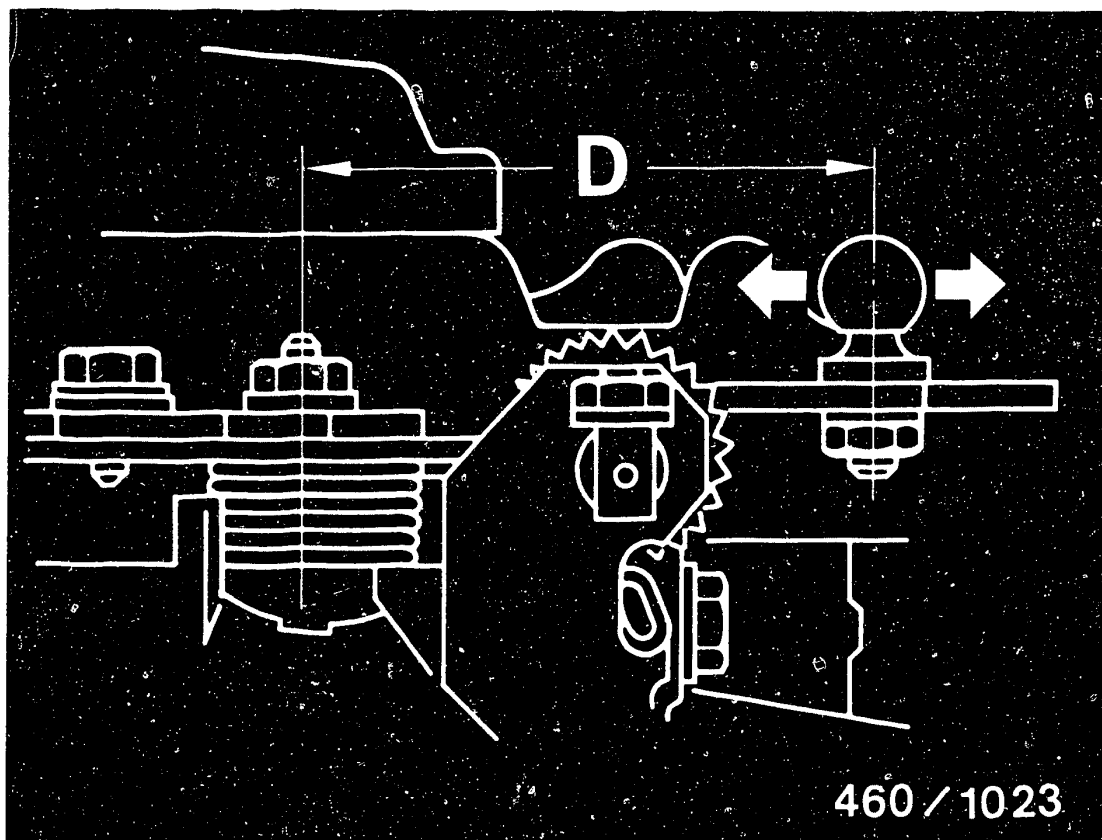
C (mm)	49	49.5	50	50.5	51	51.5	52	52.5
D (mm)	64.2	63.5	62.9	62.3	61.6	61.0	60.5	59.9

C (mm)	53	53.5	54	54.5	55	55.5	56
D (mm)	59.4	58.8	58.3	57.8	57.3	56.8	56.4

**J16**

Install fuel-injection pump  
BMW 524 td





460 / 1023

Take out the connection linkage on the control lever.

Measure dimension "D" and compare it to the setting value from the table.

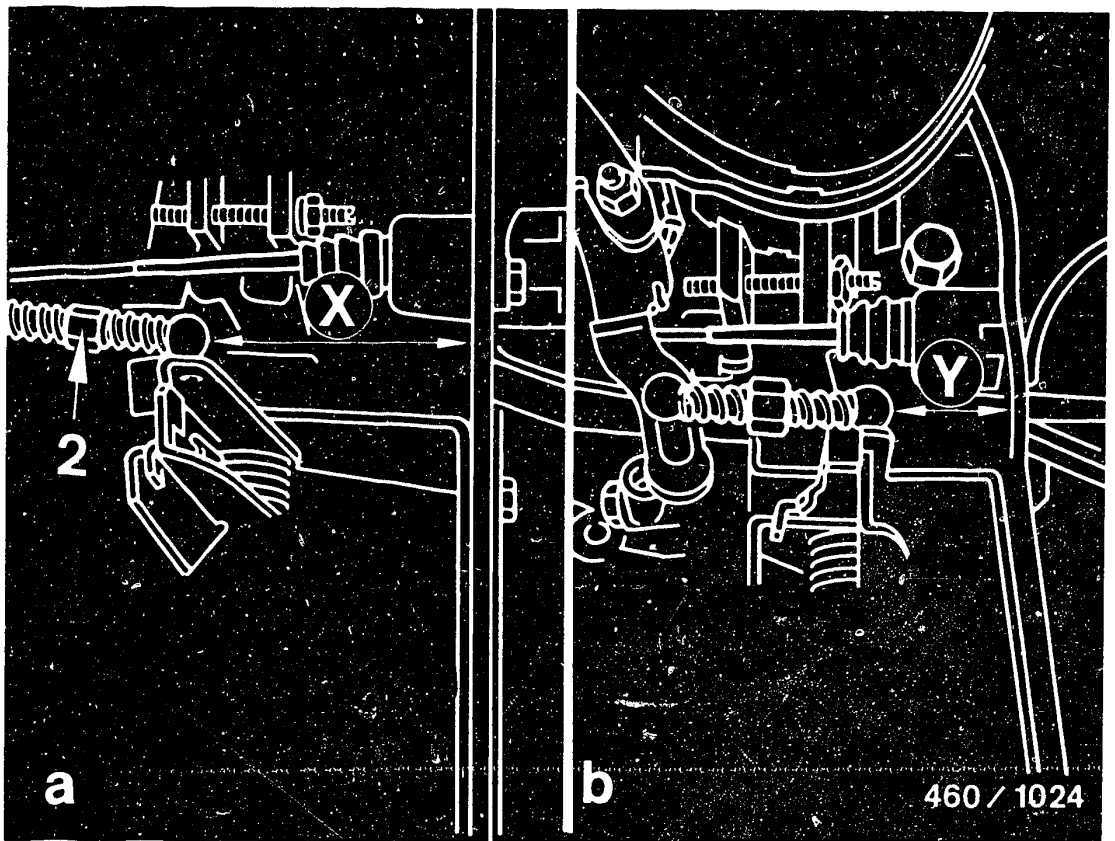
If need be, adjust dimension "D" by changing the position of the ball knob (arrows).

**J17**

Install fuel-injection pump

BMW 524 td





1. Check dimension "X" in the idle setting (Figure a).  
Setting dimension = 68 mm

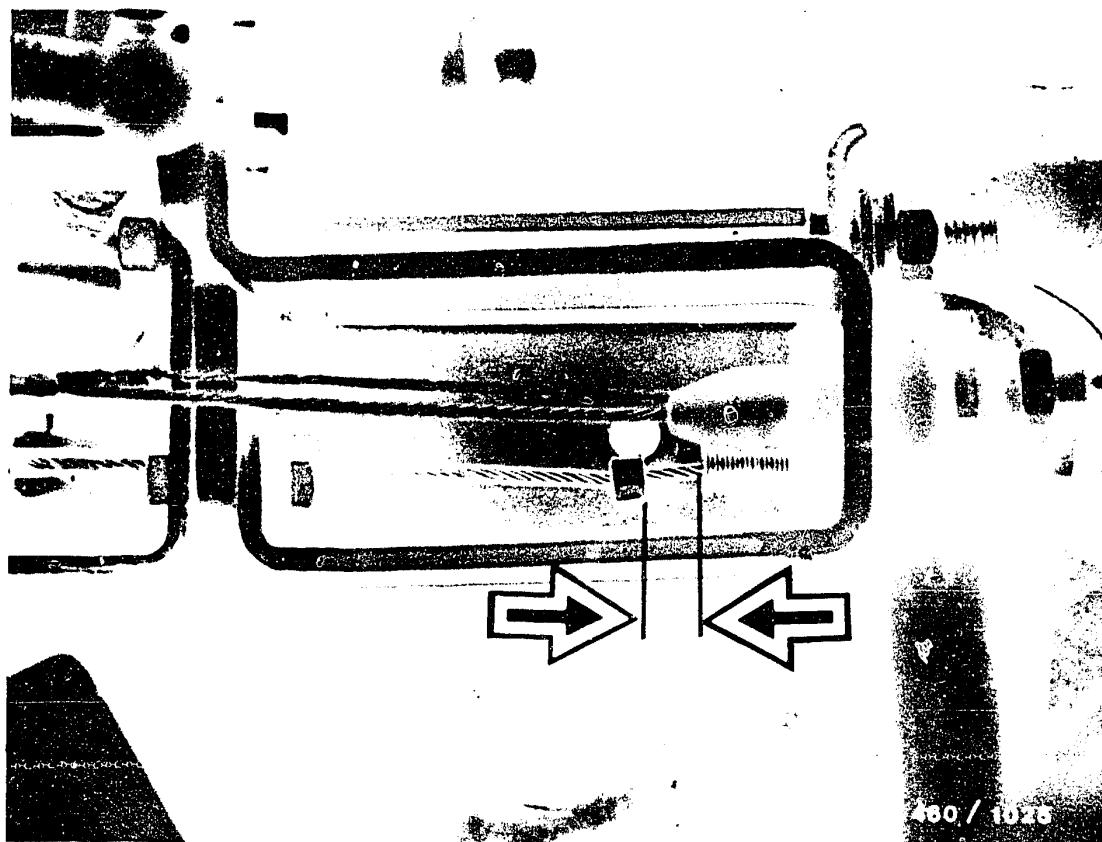
Adjustment correction on the connecting linkage (2).

2. Check the full-throttle setting (Figure b).  
Dimension "Y" must be from 28.5...29.5 mm.

If dimension "Y" is not correct, repeat the entire adjustment.

Note:

After completion of adjusting the engine-speed control lever to the shift position for the automatic transmission, check the cable adjustment for the accelerator pedal lever (adjust).



### 35.5 Kick-down adjustment

Pre-condition:

- Engine at normal operating temperature, coolant temperature  $+80^{\circ}\text{C}$ .

Adjustment:

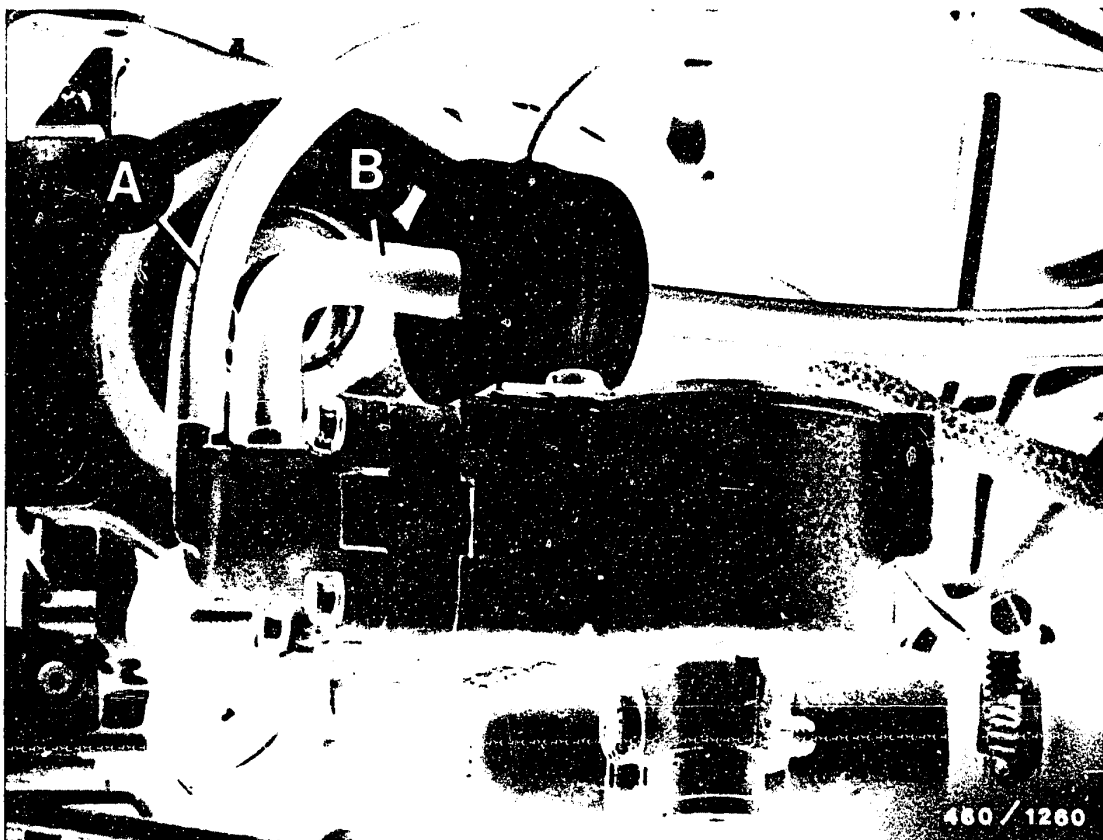
1. There must be a gap of 0.5 mm present between the cable clamp and the guide sleeve at idle speed.
2. Shut off the engine, step down on the accelerator as far as the kick-down point. Setting dimension between the cable clamp and the guide sleeve = 39 mm. Adjust by changing the guide sleeve.

**J19**

Install fuel-injection pump

BMW 524 td





## 35.6 TEST AND ADJUST EGR PRESSURE TRANSFORMER

### 35.6.1 Test pressure transformer

Requirements for testing:

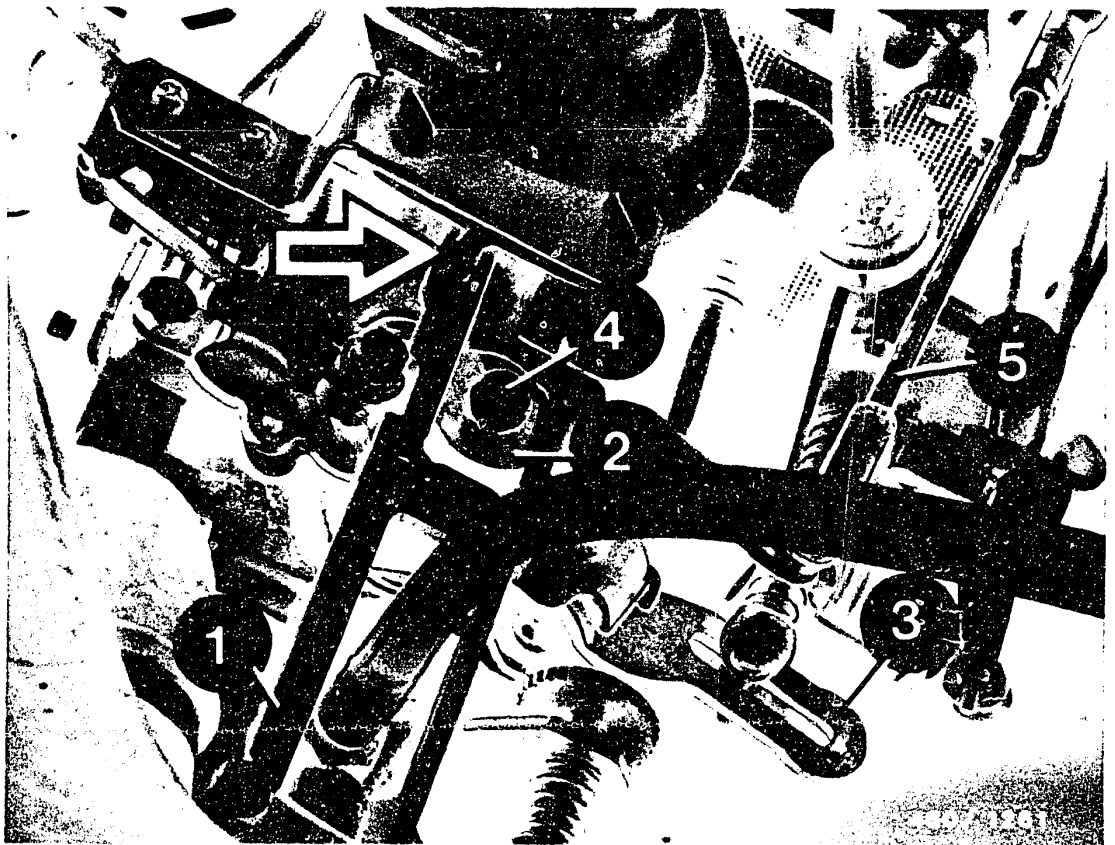
- Idle speed  $750 \dots 800 \text{ min}^{-1}$
- Maximum speed  $4800 \text{ min}^{-1}$
- temperature-dependent idle increase inoperative (control lever up against idle stop).

Leave on connecting hose (black-red) between vacuum pump (engine) and pressure transformer port "A".

Disconnect vacuum hose (black-blue) from port "B".

Connect vacuum measuring instrument to unoccupied port "B".





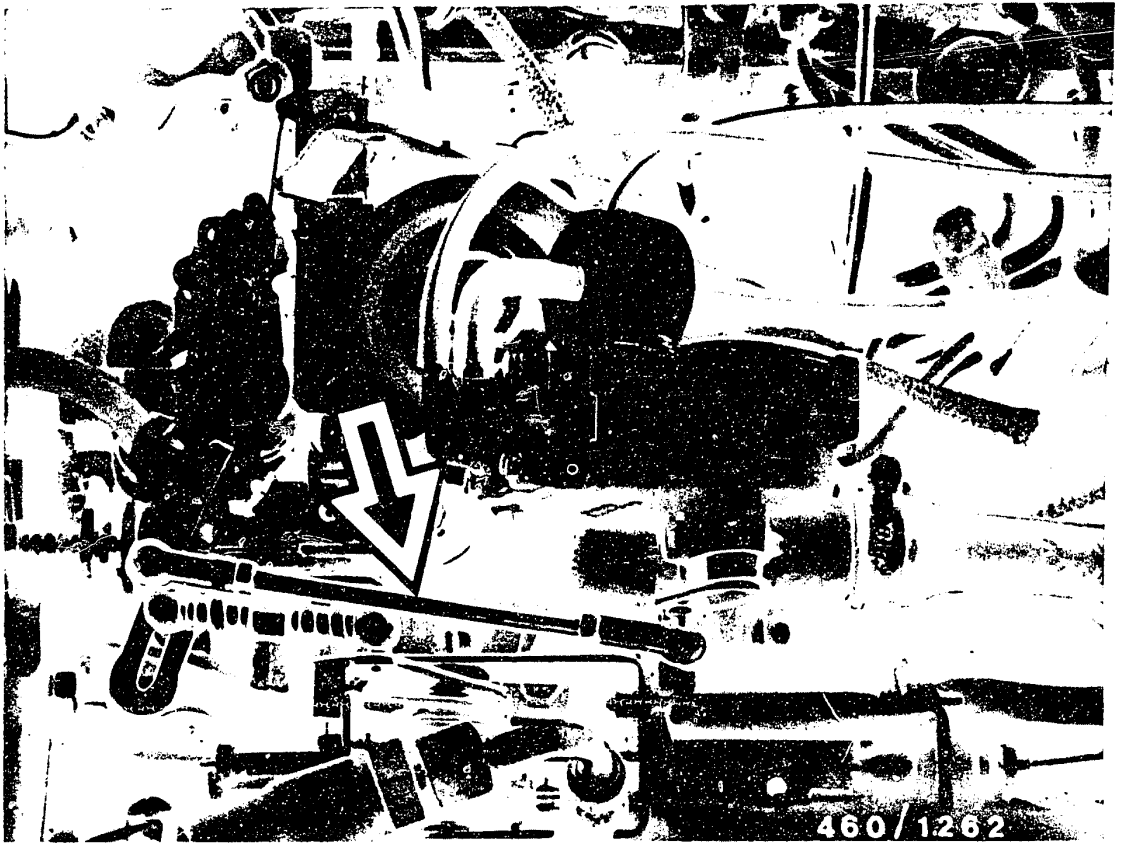
Slide feeler gauge KDEP 1142 (1) over EGR coupling cable (2) and, by turning the control lever (3), fix feeler gauge in web of manifold-pressure compensator housing (arrow).

With the control lever in this position, a setting pressure of 357...363 mbar (checking pressure 350...370 mbar) must be indicated on the vacuum gauge (port "B").

At least 550 mbar must be present as inlet pressure at the pressure transformer (port "A").

Note:

Do not loosen fastening screw (4) of EGR coupling part since otherwise a basic setting from the injection-pump test bench will be necessary.



### 35.6.2 Adjust pressure transformer

If the control pressure is not obtained, the vacuum can be corrected by changing the length of the connecting rod (arrow).

Shortening = Raising of control pressure

Lengthening = Reducing of control pressure

After tightening the lock nuts (connecting rod), check the adjustment again.





## 36. TEST AND ADJUST ENGINE TIMING

### 36.1 Test engine timing

Disconnect negative cable from battery.

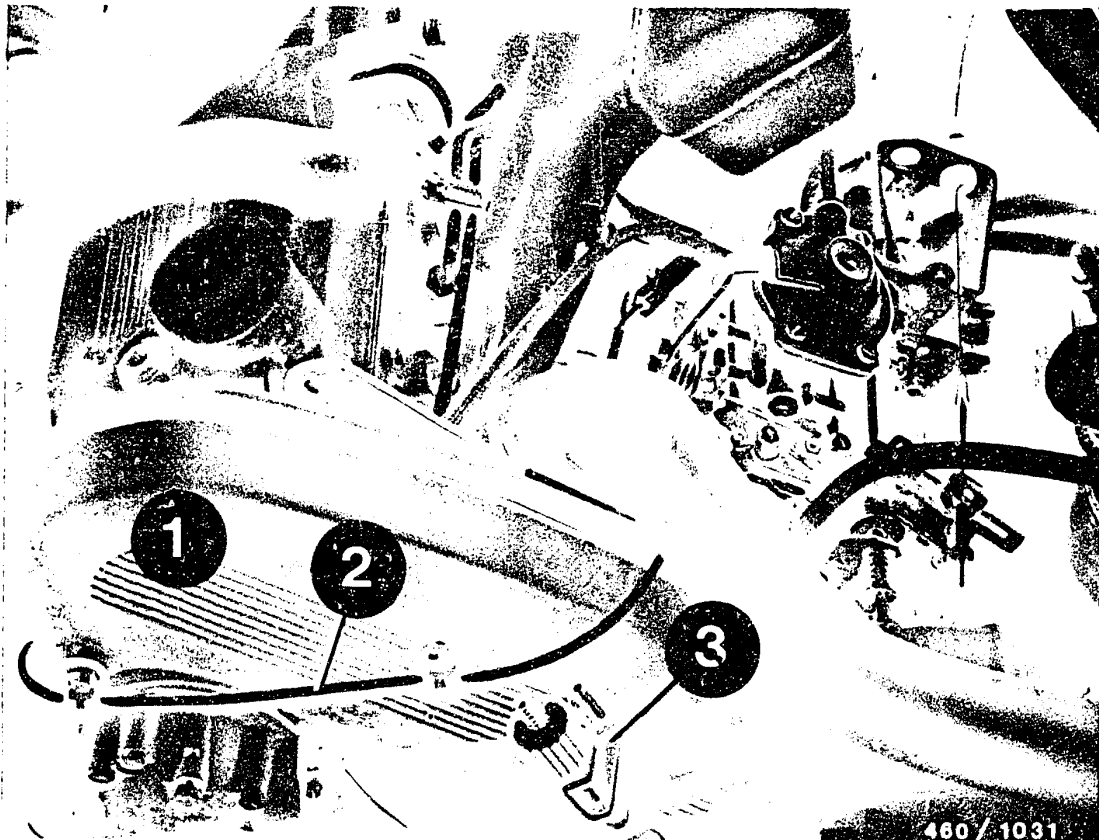
Turn crankshaft until TDC mark (cylinder 1) on the pulley aligns with reference mark (arrow).

The piston of cylinder 1 is at TDC (valves of cylinder 6 on overlap).

**K1**

Test and adjust engine timing  
BMW 524 td





1 = Toothed-belt cover  
2 = Wiring harness

3 = Hose clammer

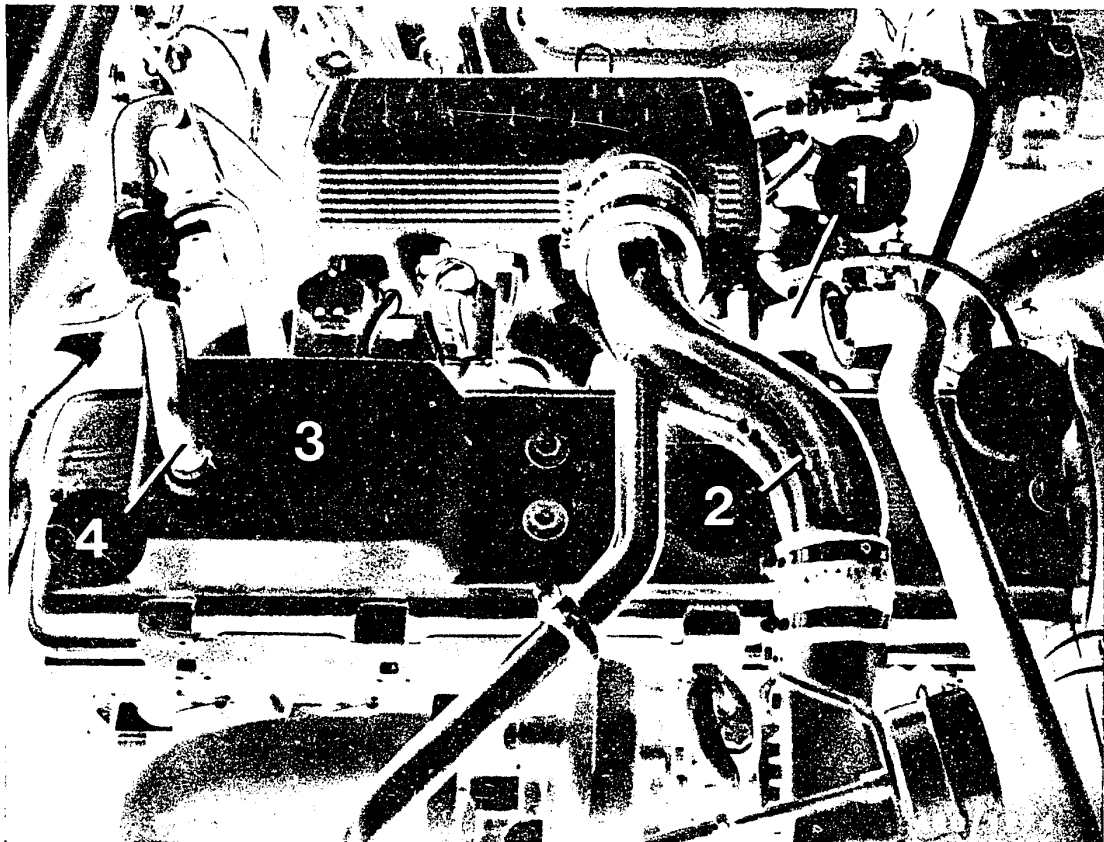
Remove wiring harness.

Pinch off cooling-water hose just after water pump using commercially available hose clammers.

Loosen hose clip and pull off cooling water hose.

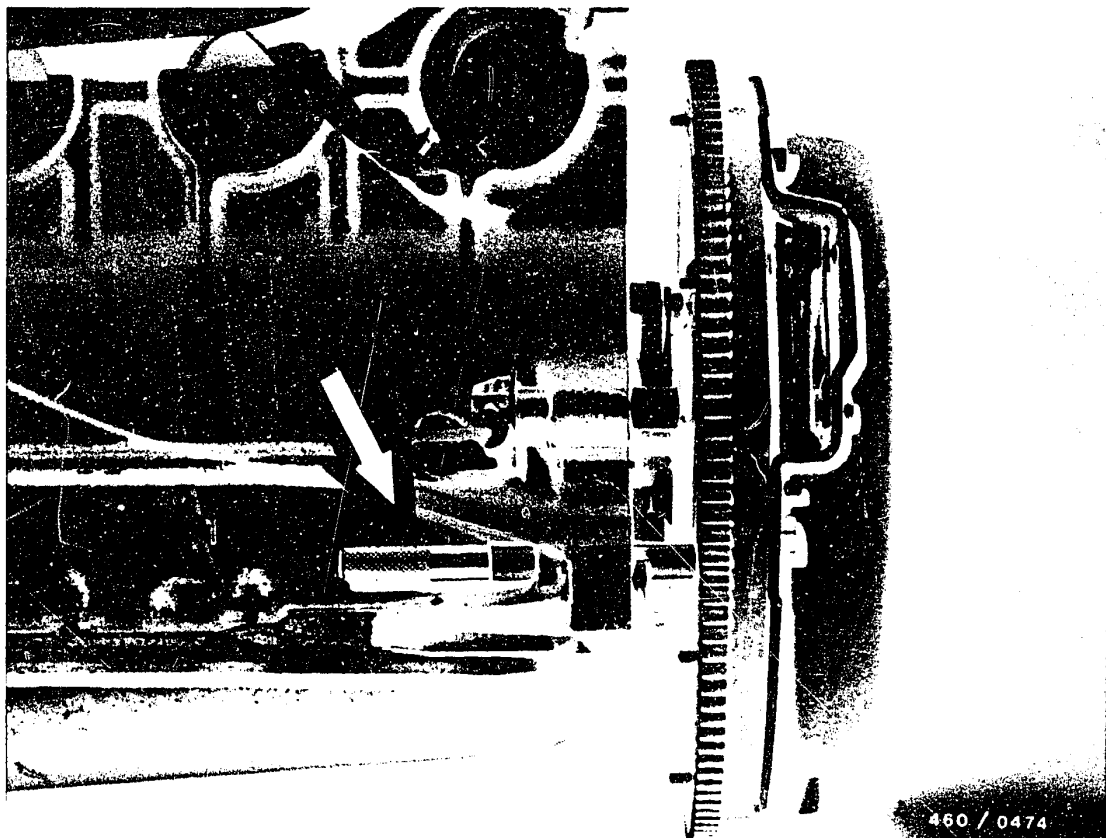
Catch cooling water.

Remove toothed-belt cover.



Remove crankcase ventilation pipe (1), connecting pipe between turbocharger and charge-air pipe (2) as well as cylinder head cover (3).

Disconnect vacuum hose from vacuum pump (4).



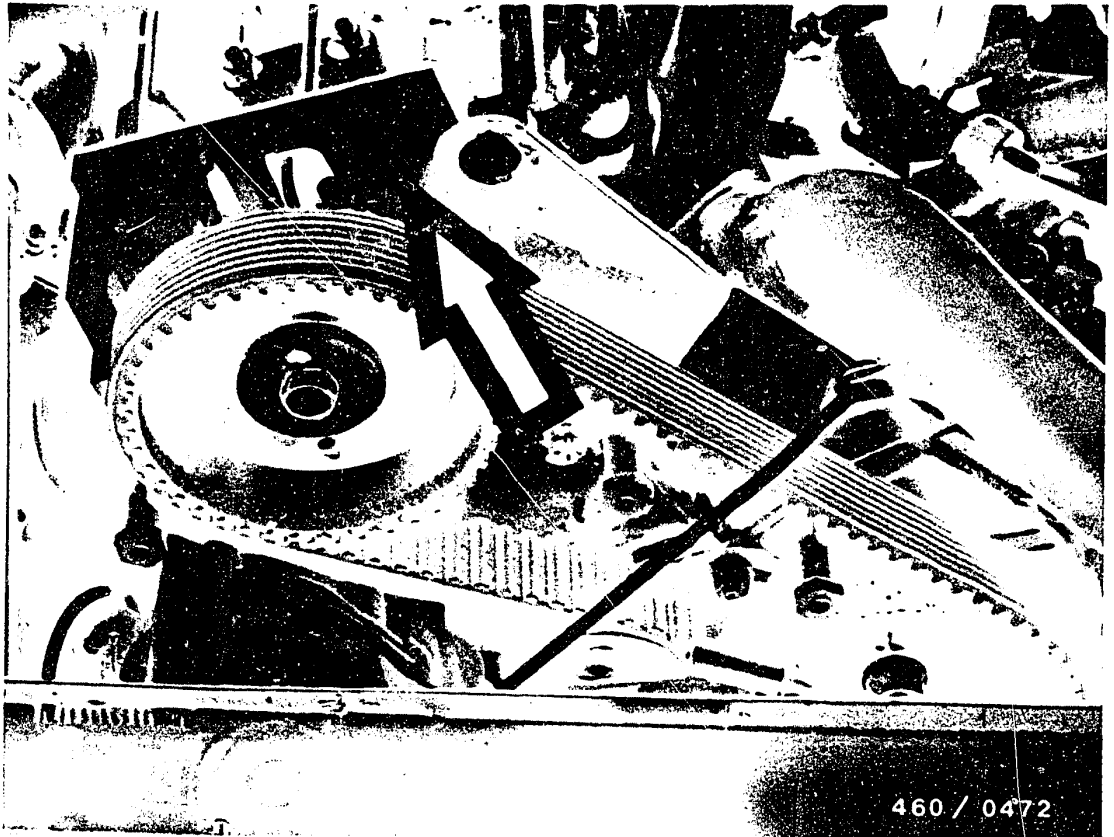
Fix the flywheel in place using setting mandrel KDEP 1139 (arrow).

**K4**

Test and adjust engine timing

BMW 524 td





Lock the camshaft using locking device KDEP 1136 (arrow).

The valves of cylinder 6 are on overlap.

**K5**

Test and adjust engine timing  
BMW 524 td



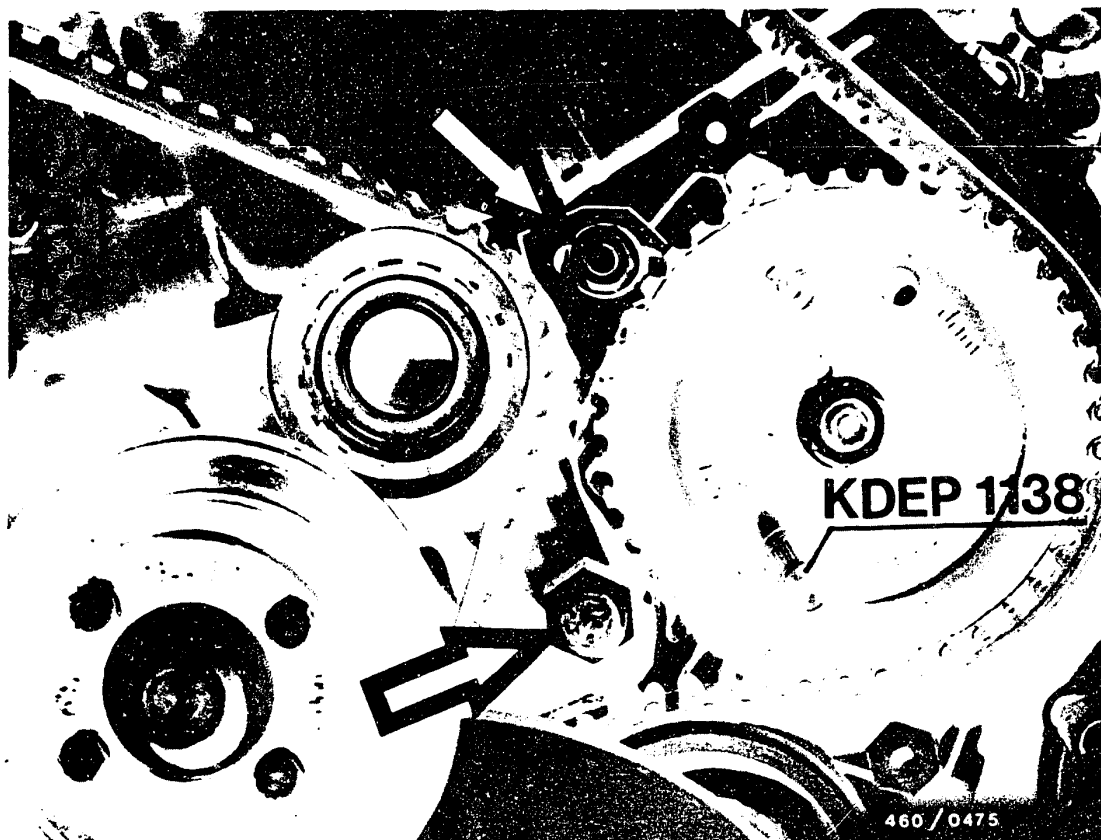


Note:

The locking device fits only over the two machined surfaces of the square (arrows).

If the locking device cannot be put on, correct the engine timing.





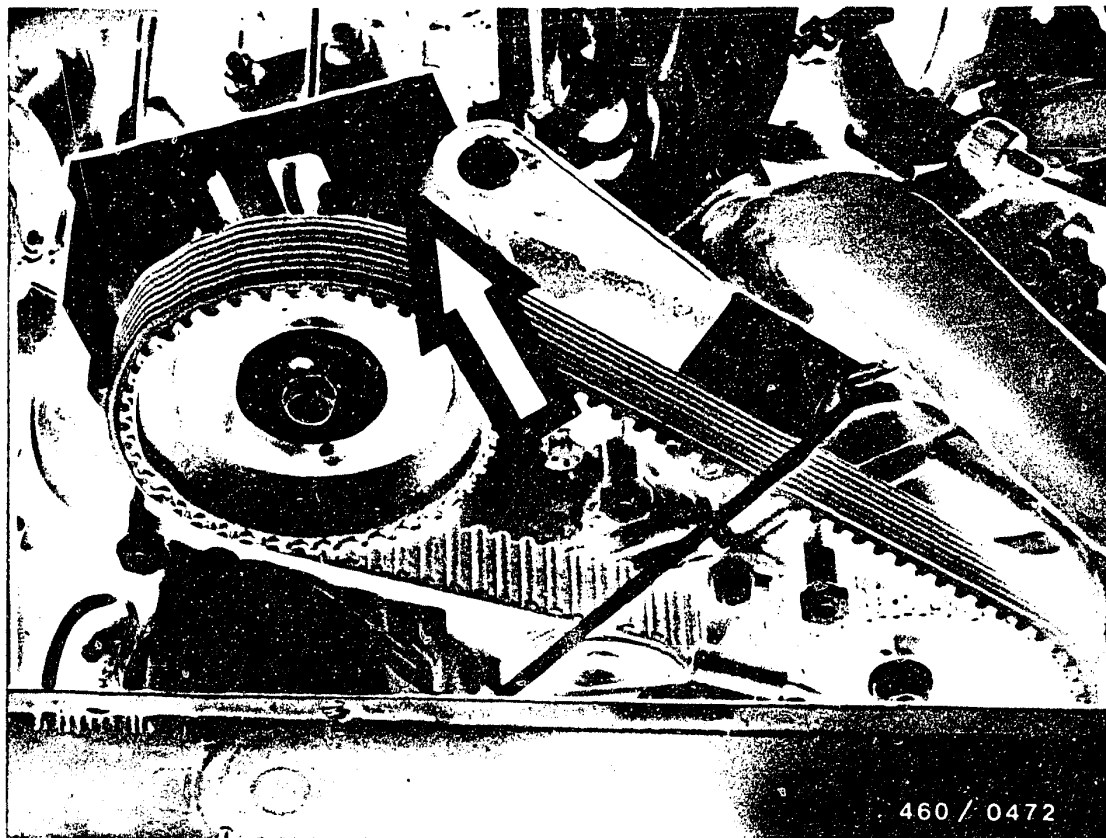
### 36.2 Adjust engine timing

Lock injection-pump gear with setting mandrel KDEP 1138.

Release the fastening nut/screw of the tensioning wheel bracket (arrows).

Relax toothed belt and remove.





Turn the camshaft until the locking device can be put on over the machined surfaces of the square:

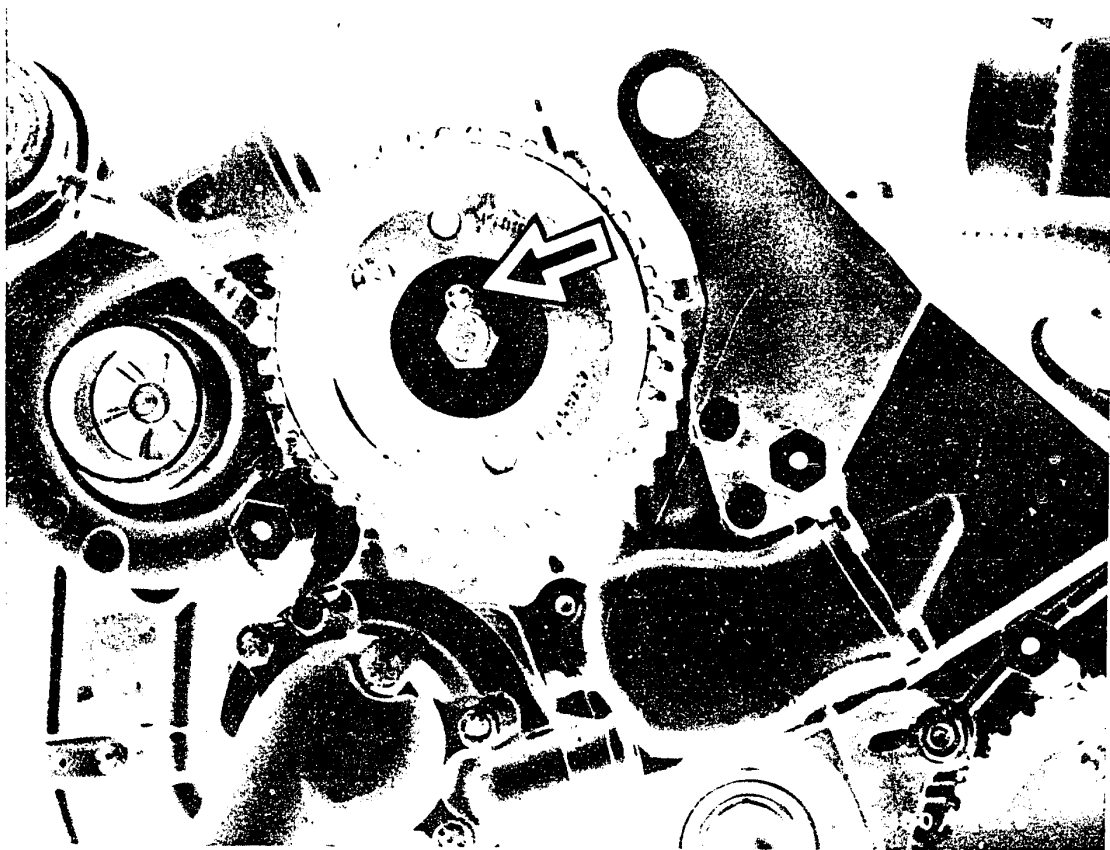
Note:

Do not remove setting mandrel KDEP 1139 and KDEP 1138.

**K8**

Check and adjust engine timing  
BMW 524 td





Release the fastening screw for the camshaft gear.

Bring the camshaft gear up to the stop against the pin  
in the direction of operation (arrow).

Finger-tighten fastening screw for the camshaft gear.

**K9**

Test and adjust engine timing

BMW 524 td



Place toothed belt in position.

Notes:

If a used toothed belt is to be re-used, it may only be mounted in the previous running direction.

Take out and replace porous or worn-out toothed belts. If a toothed belt is not being replaced, then continue at Coordinate K19. No continuation here is required.

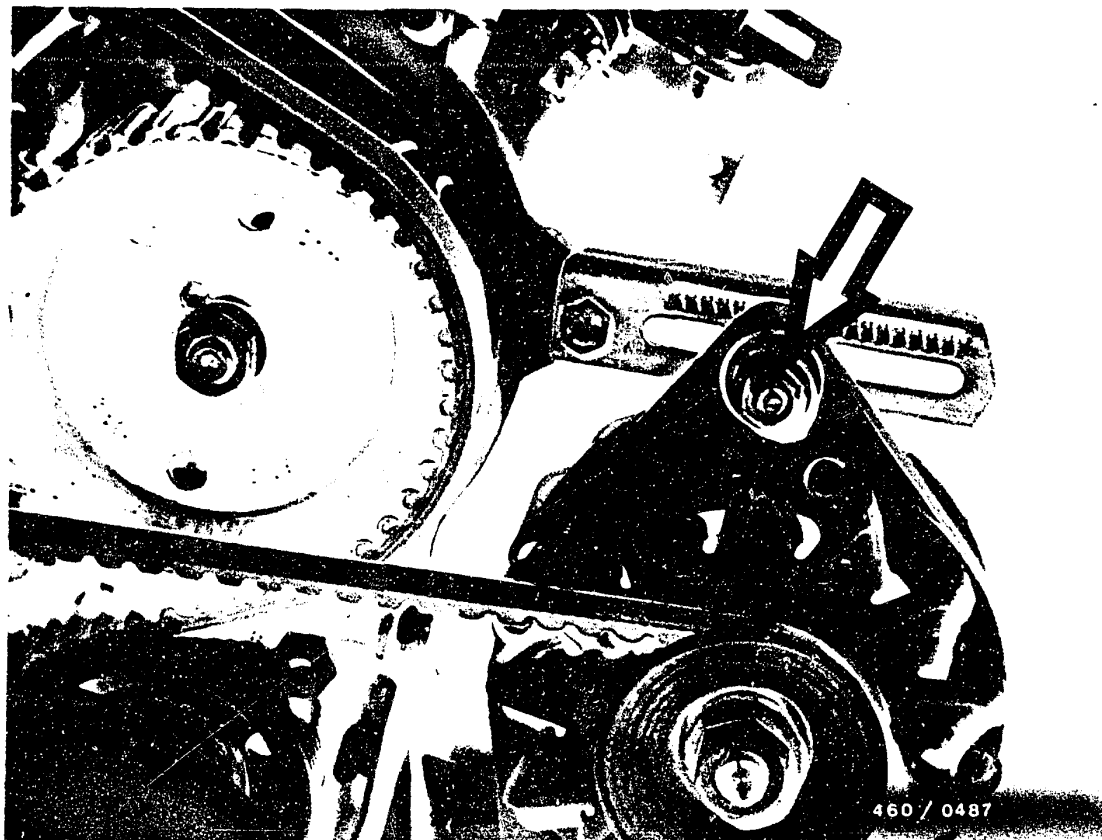
Never turn the crankshaft or camshaft without the toothed belt mounted so that the valves do not hit the pistons.

**K10**

Test and adjust engine timing

BMW 524 td





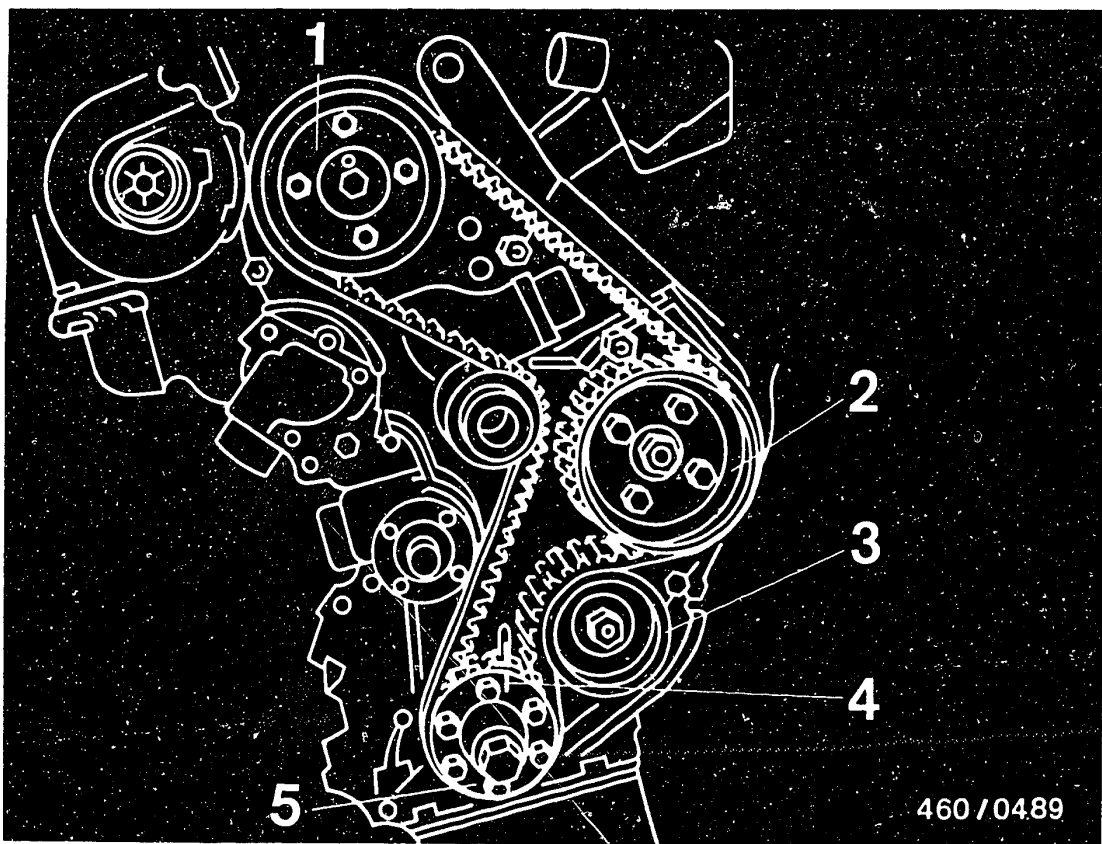
### 36.2.2 Replace toothed belt

Loosen fastening screw (arrow) on alternator and remove V-belt.

**K11**

Test and adjust engine timing  
BMW 524 td





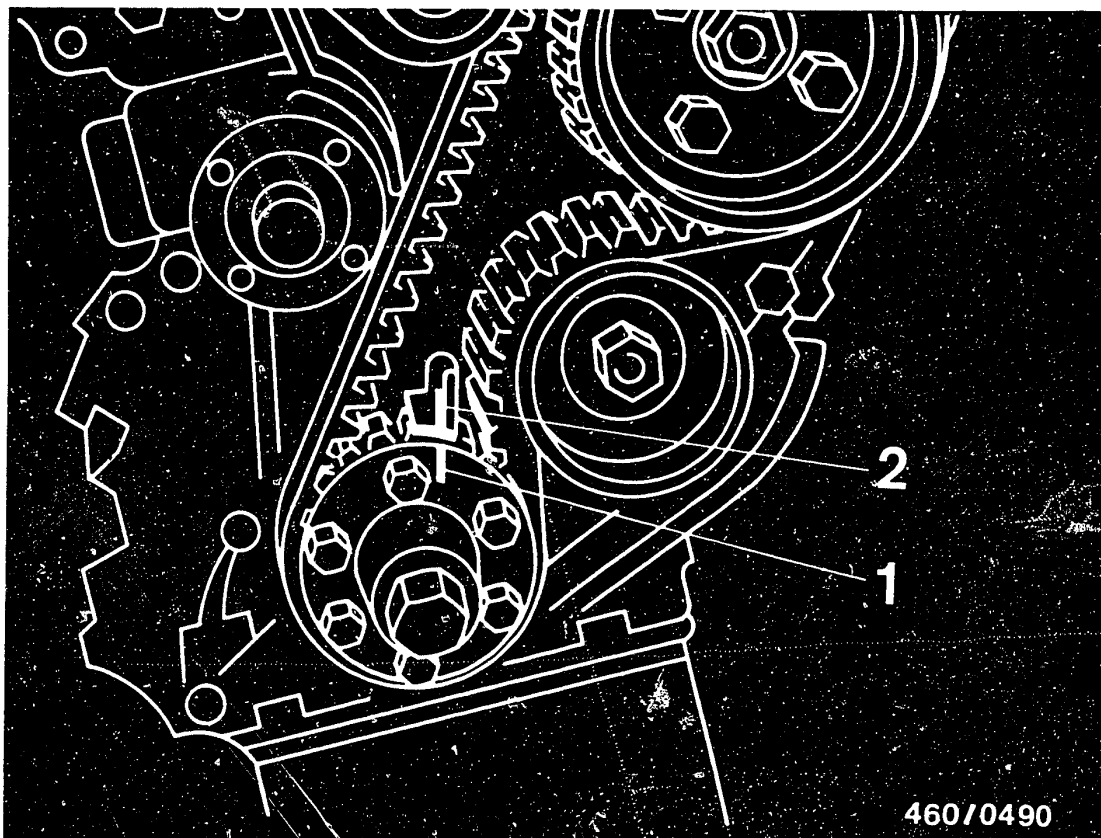
460/0489

- 1 = Camshaft gear
- 2 = Injection-pump gear
- 3 = Toothed-belt pulley of intermediate shaft
- 4 = Mark on vibration damper
- 5 = Vibration damper hub

Remove the V-belt pulley (vibration damper) from the vibration damper hub on the crankshaft.

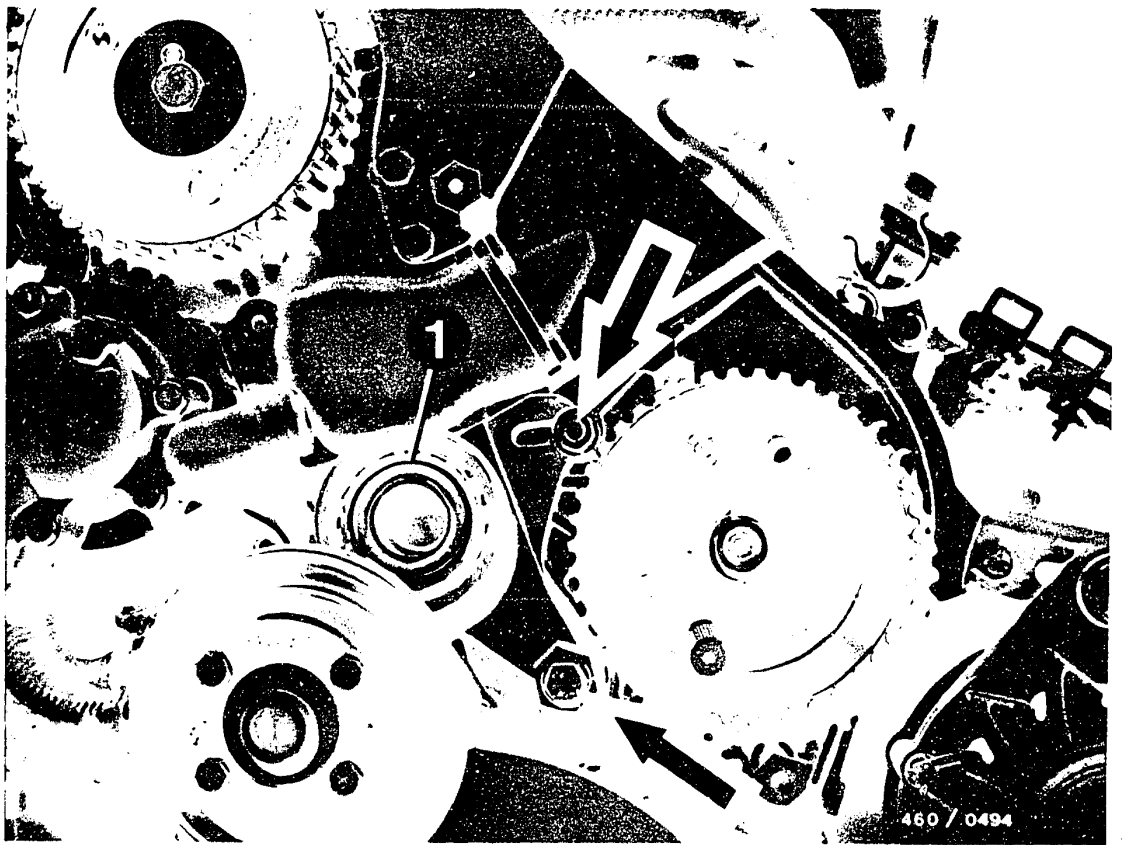
Removed toothed belt.





- 1 = Mark on vibration damper
- 2 = Reference mark on toothed belt cover

Before mounting the toothed belt, check whether the mark on the vibration damper hub of the crankshaft is in alignment with the reference mark on the rear toothed belt cover.

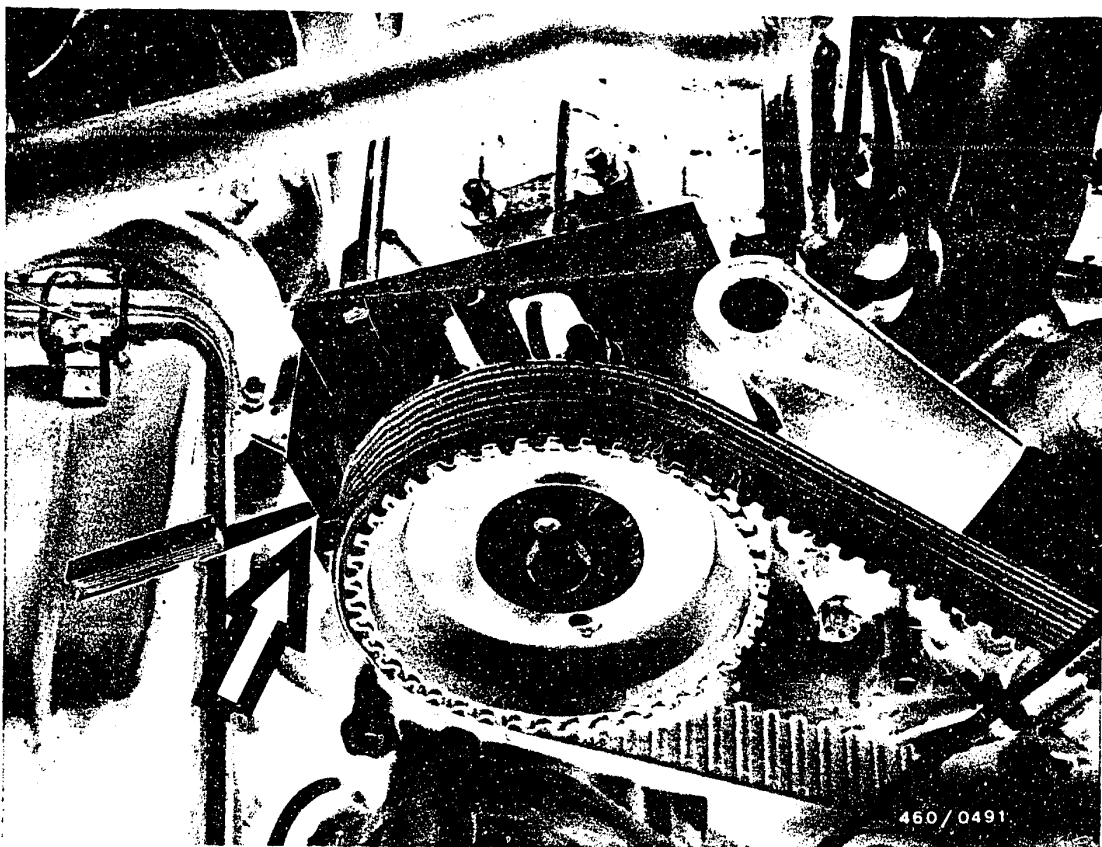


1 = Tensioning roller

Finger-tighten the fastening nut/screw for the tensioning wheel bracket (arrows).

Starting from the crankshaft gear, place the toothed belt in the teeth of the injection-pump gear and, still under tension, over the camshaft gear.





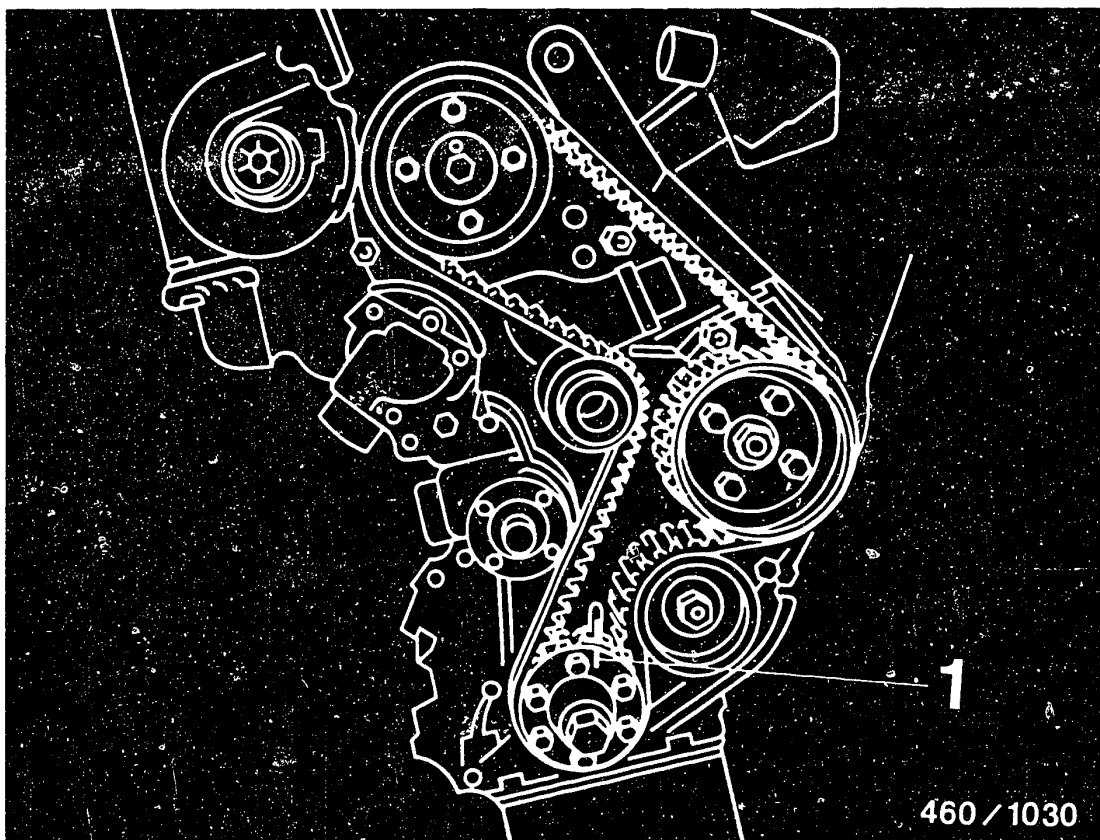
Note:

In the case of a new toothed belt, place a 2.5 mm feeler gauge (arrow) between the sealing surface for the cylinder head cover and the locking device KDEP 1136 on the outlet side.

**K15**

Test and adjust engine timing  
BMW 524 td





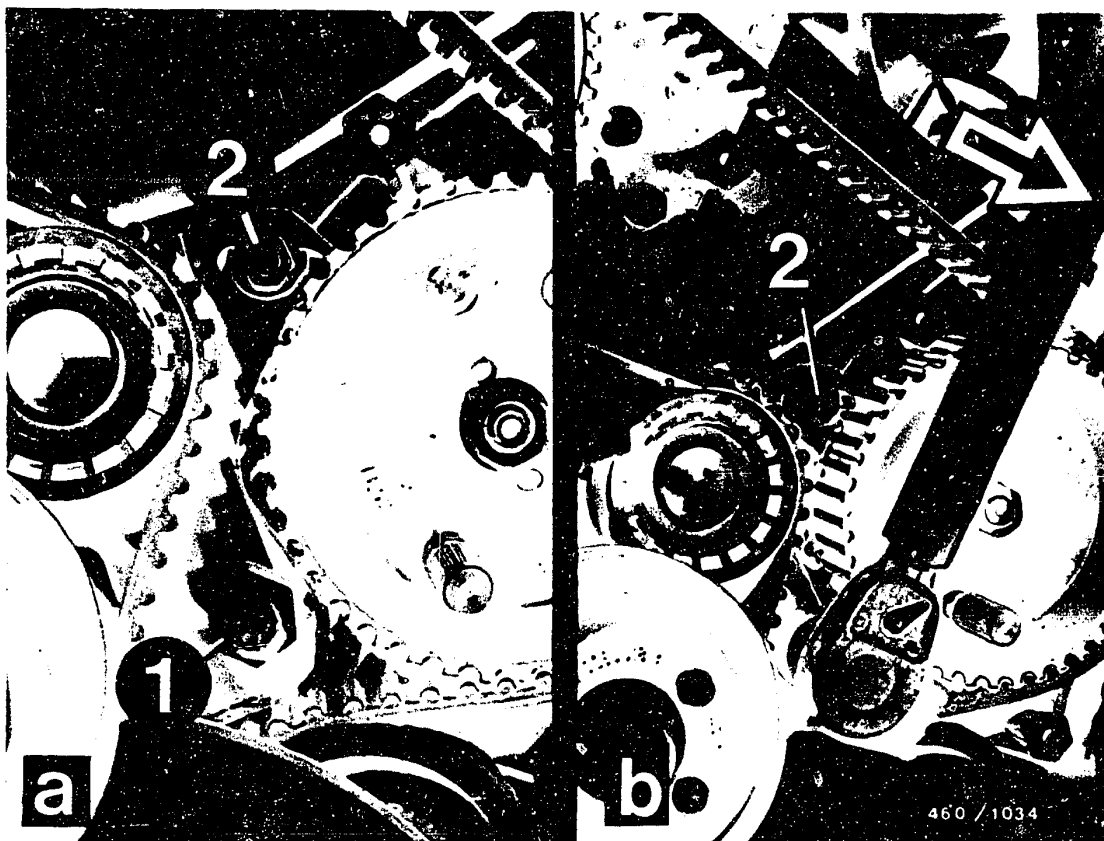
460 / 1030

Put the V-belt pulley on the vibration damper hub (1) of the crankshaft and tighten it to 22...24 Nm.

**K16**

Test and adjust engine timing  
BMW 524 td





1 = Tensioning point      2 = Upper fastening nut

Remove setting mandrel (KDEP 1138) from injection-pump gear.

Caution:

Toothed belt must not jump.

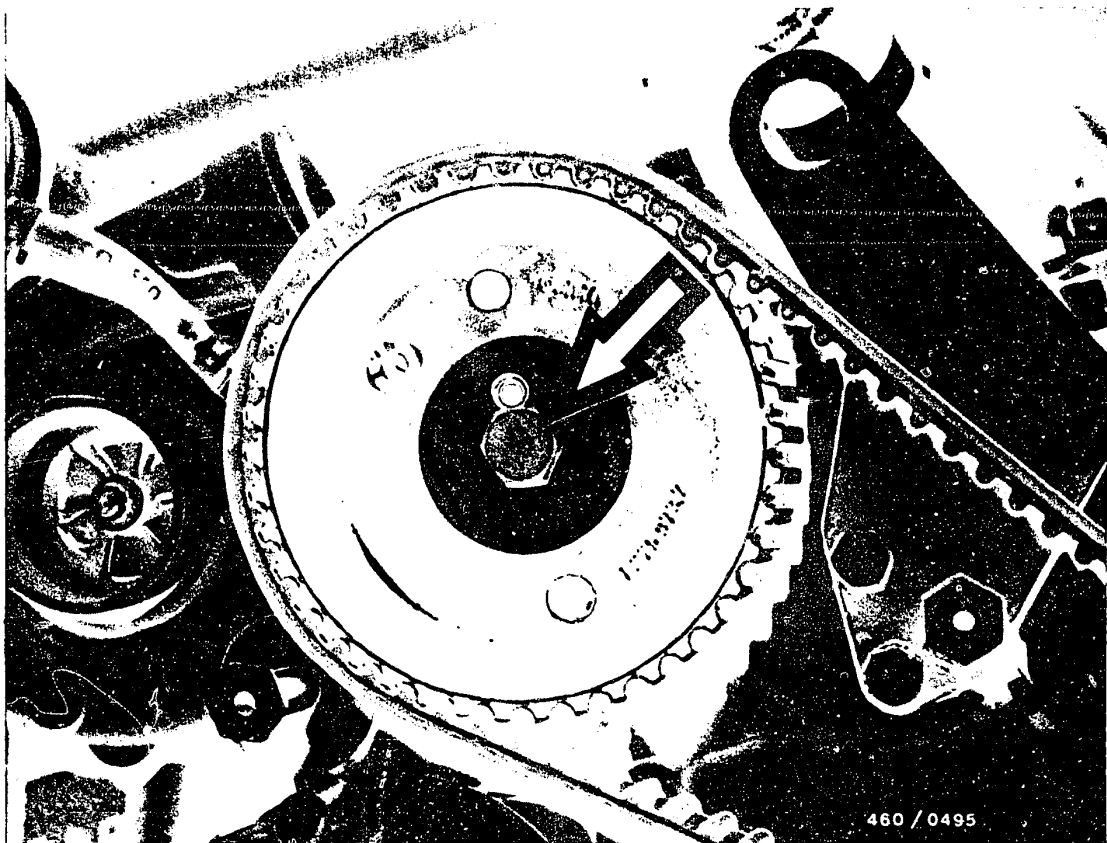
Pivot the tensioning roller against the back of the toothed-belt with 45...50 Nm at the clamping point (1) and tension the toothed-belt.

Tighten the fastening nut at the top (2) to 20...24 Nm.

Note:

Use only torque wrench with pointer (adjustable wrenches are not suitable).

Remove the torque wrench and tighten the fastening screw at the bottom (1) to 20...24 Nm.



Tighten camshaft gear to specified torque 65...70 Nm (arrow).

Remove locking device KDEP 1136 from camshaft and remove setting mandrel KDEP 1139 from flywheel.

Lay V-belt on alternator and tension.

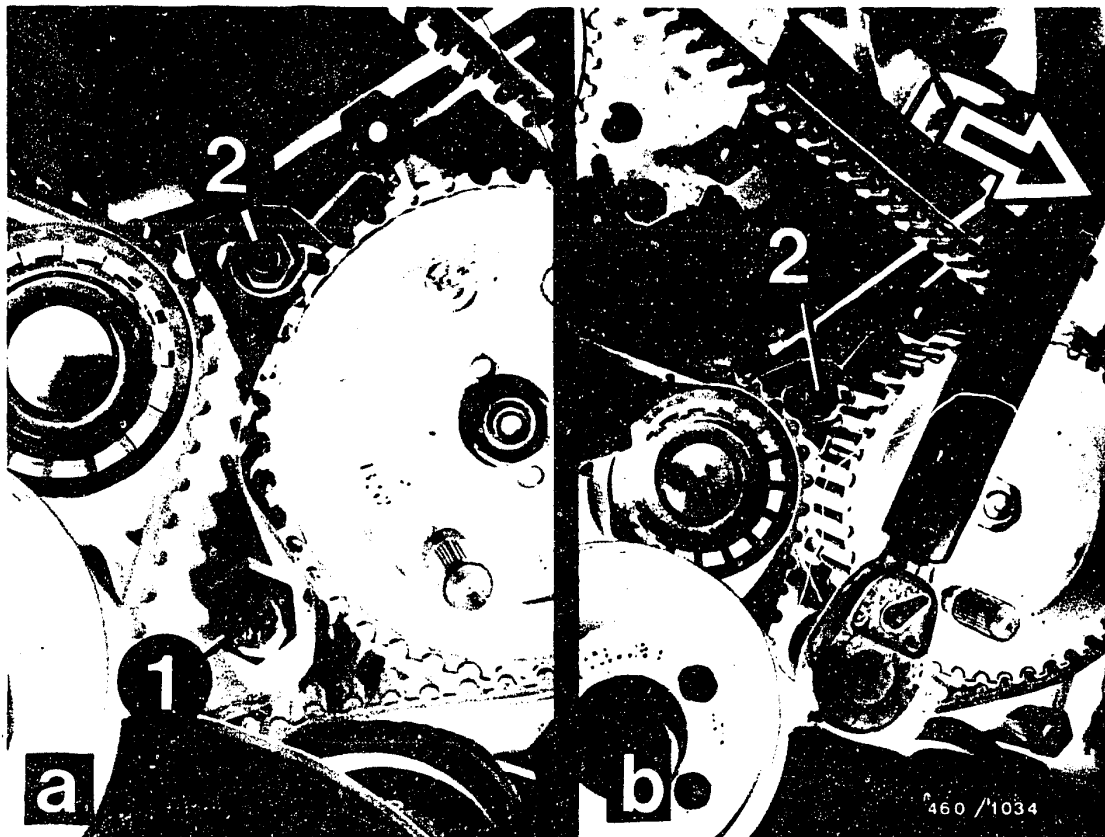
Section on changing the "toothed belt" completed.  
Continue testing and adjusting on Coordinate K 21.

**K18**

Test and adjust engine timing

BMW 524 td





1 = Clamping point

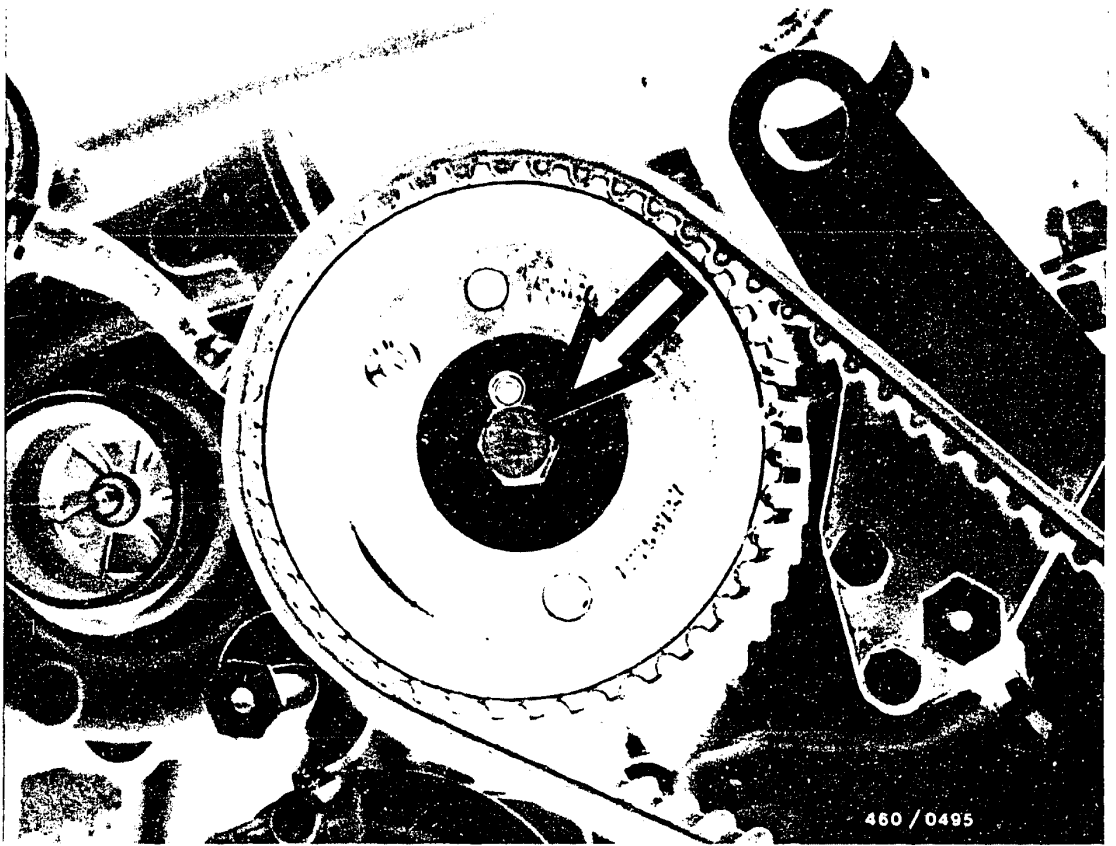
2 = Top fastening nut

Pivot setting mandrel with 45...50 Nm (toothed belt having been used for over 16 000 km (10 000 miles) 30...35 Nm) at the tensioning point against the back of the toothed belt (arrow) and tension toothed belt. Tighten upper fastening nut (2) to 20...24 Nm.

Note:

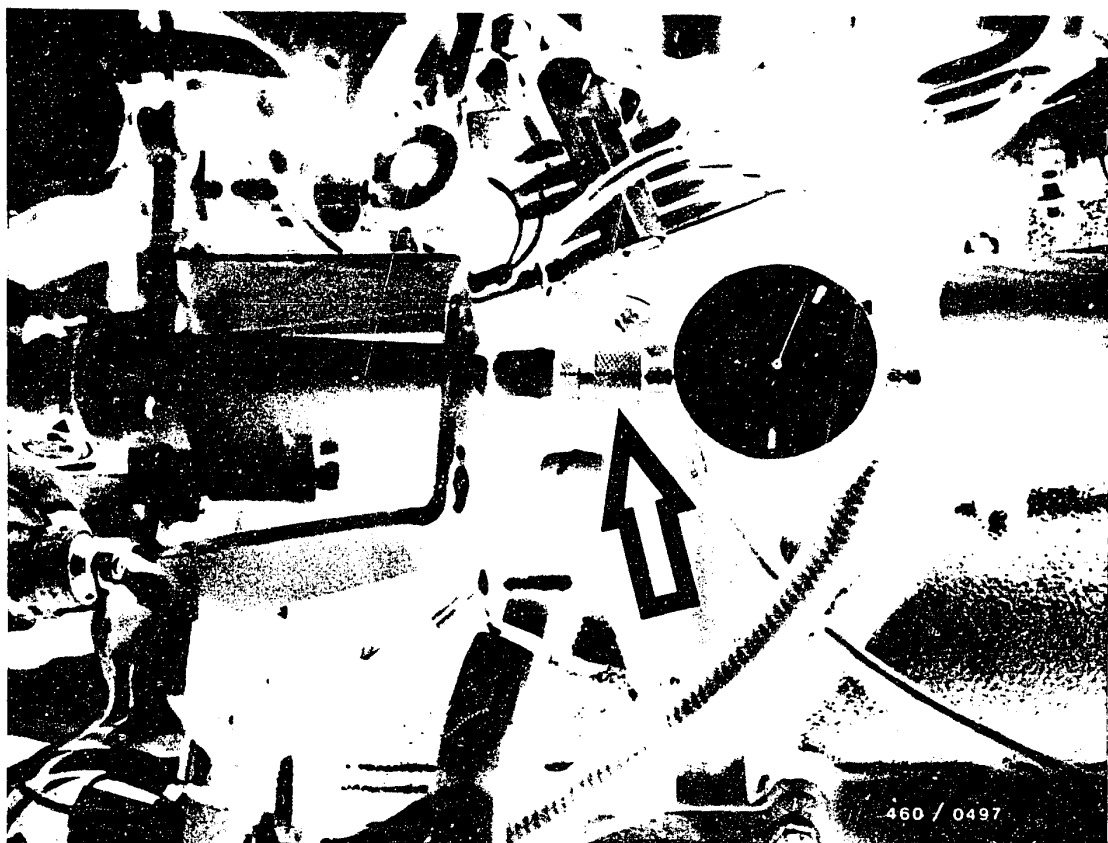
Use only torque wrenches with needles. (Adjustable wrenches are not suitable.)

Remove the torque wrench and tighten the bottom fastening screw (1) to 20...24 Nm.



Tighten camshaft gear to specified torque 55...65 Nm (arrow).

Remove locking device KDEP 1136 from camshaft and remove setting mandrel KDEP 1139 from flywheel.



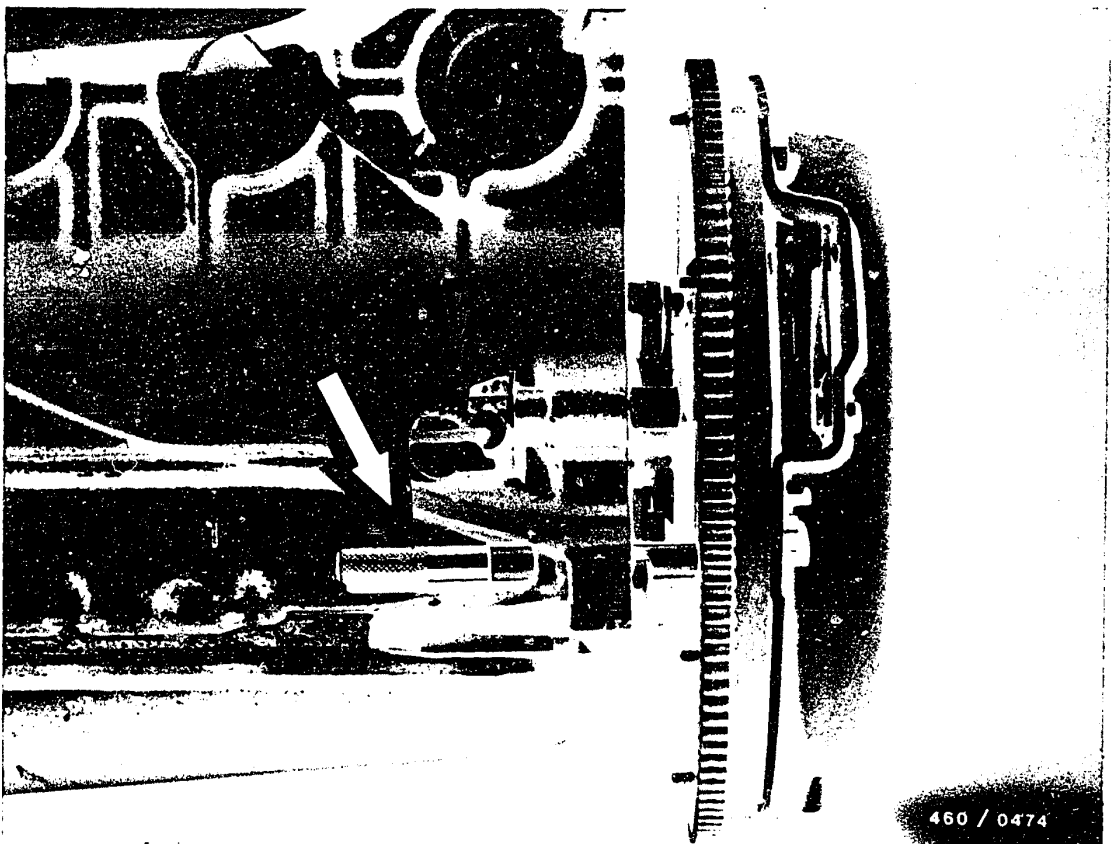
Remove injection lines from injection pump and from nozzle holders (prevent delivery-valve holders from coming loose by holding with a wrench).

Unscrew bleeder screw from central screw plug (triangular plug) of hydraulic head.

Screw measuring tool KDEP 1085 (arrow) into the tapped hole of the bleeder screw.

Mount mini dial indicator with measuring insert in measuring tool KDEP 1085.





Preload dial indicator by approx. 2.5 mm.

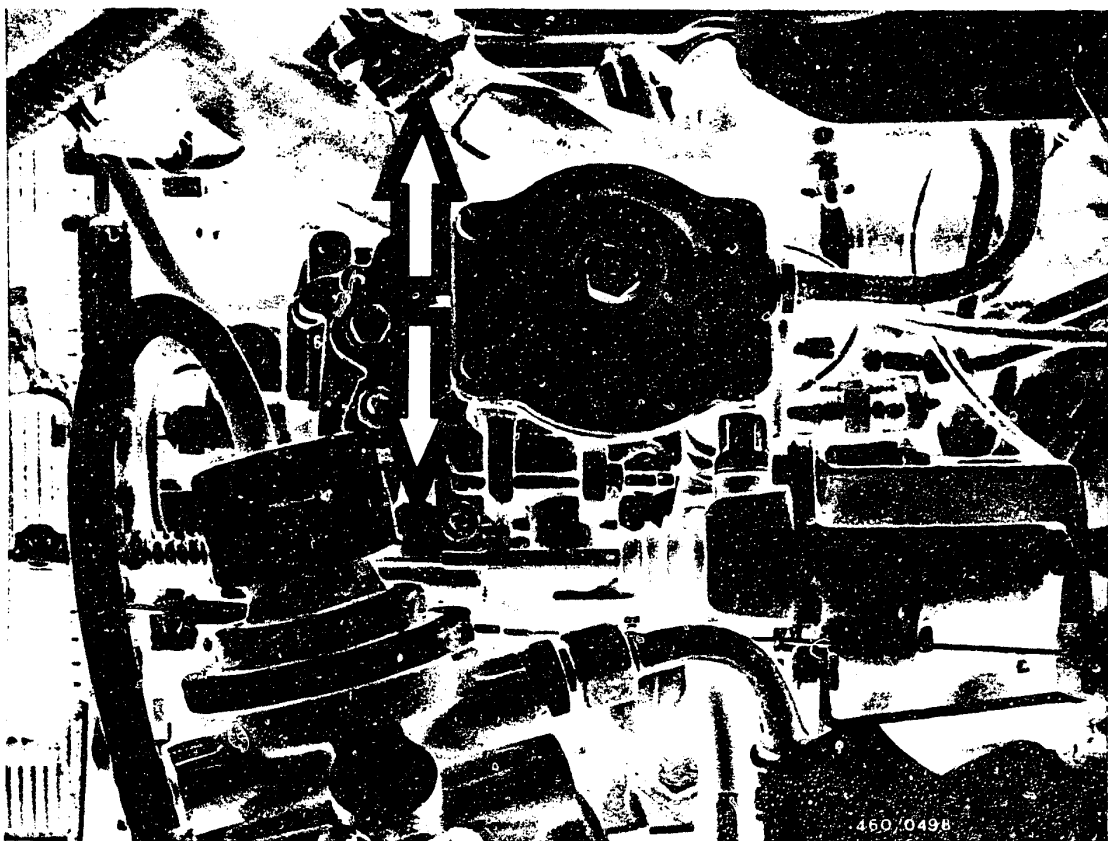
Turn crankshaft slowly against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

Turn crankshaft in engine direction of rotation until cylinder 1 is at TDC.

Fix the flywheel in place using setting mandrel KDEP 1139 (arrow).





In this position, the dial indicator must indicate a stroke of:

0.65 mm ABDC (setting value)

0.61...0.69 mm ABDC (checking value).

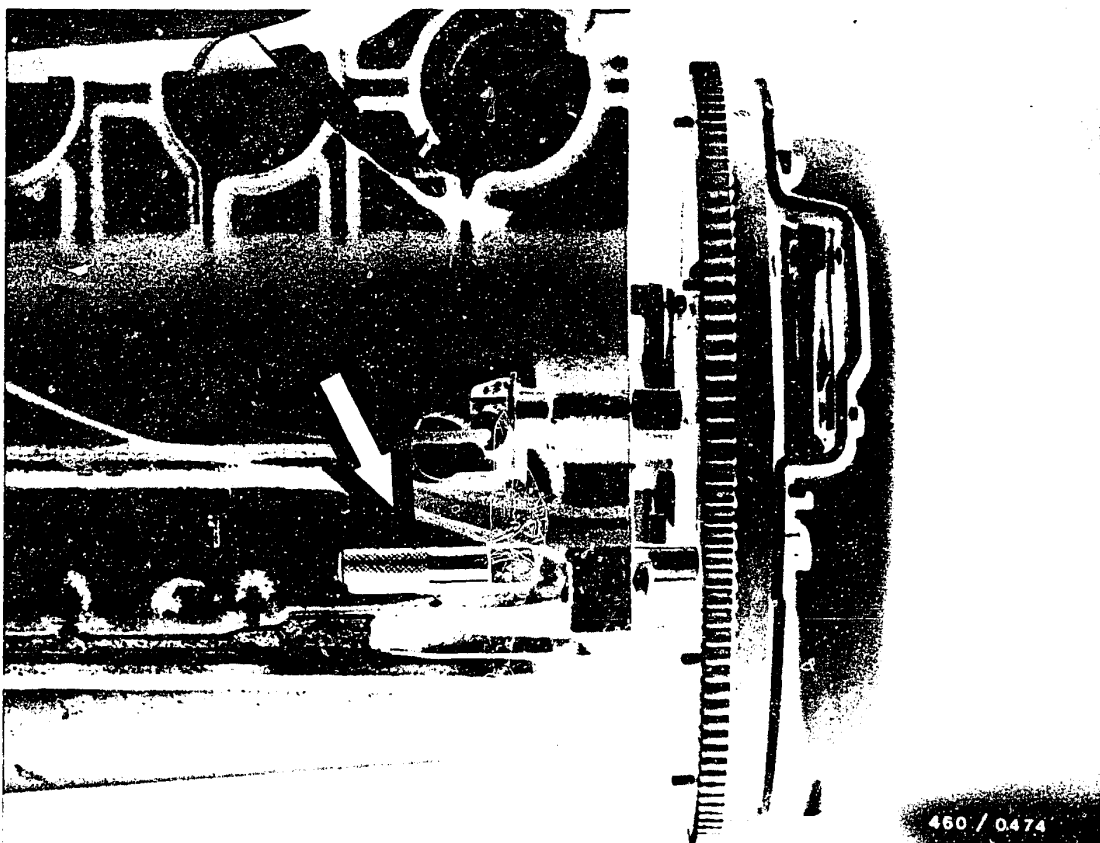
If a correction is necessary, loosen injection pump fastening screws.

Pivot injection pump until a stroke of 0.65 mm is obtained.

If the reading is too small, pivot pump toward engine.

If reading is too great, pivot pump away from engine.





Tighten injection pump fastening screws to 25 Nm.

Remove setting mandrel KDEP 1139 (arrow).

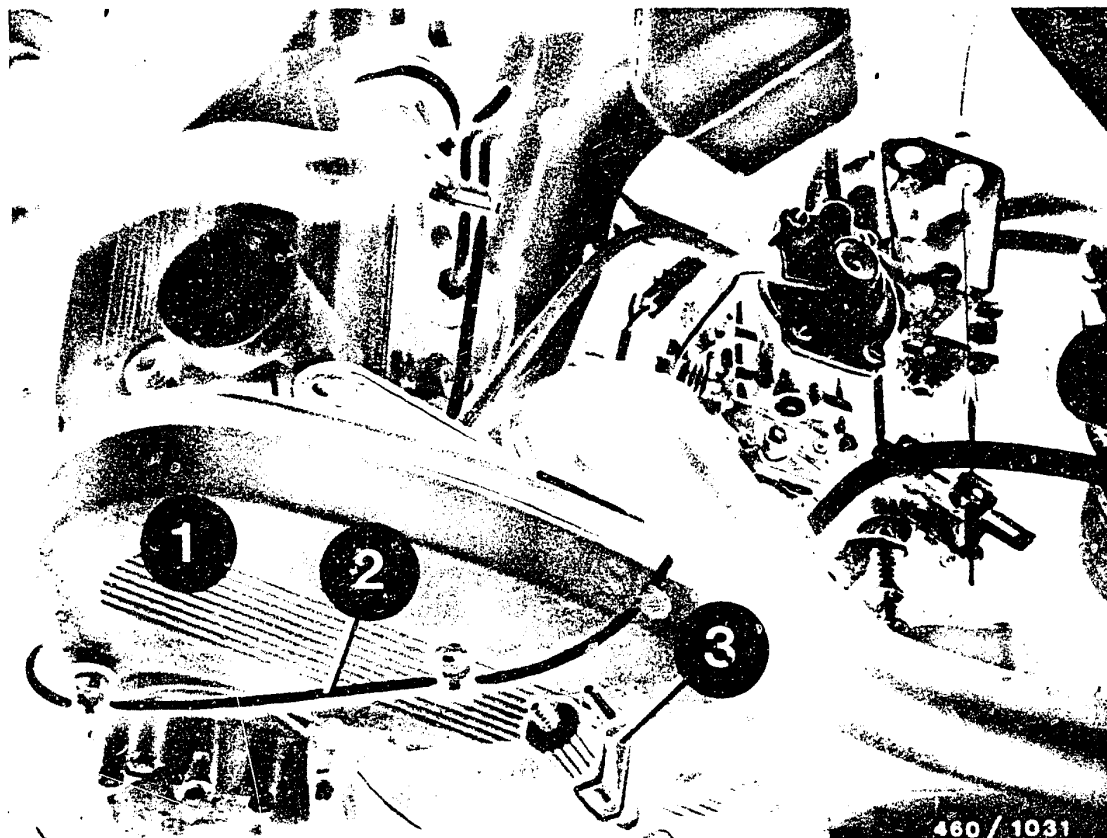
Turn crankshaft over twice and check setting.

Remove measuring tool KDEP 1085 with dial indicator.

Mount bleeder screw with new seal ring.

Tighten the support bracket for the fuel-injection pump to 20...24 Nm.

Using open-end box wrench KDEP 1115, tighten the fuel injection lines. (Prevent the pressure valve holders from turning by holding with a wrench.)

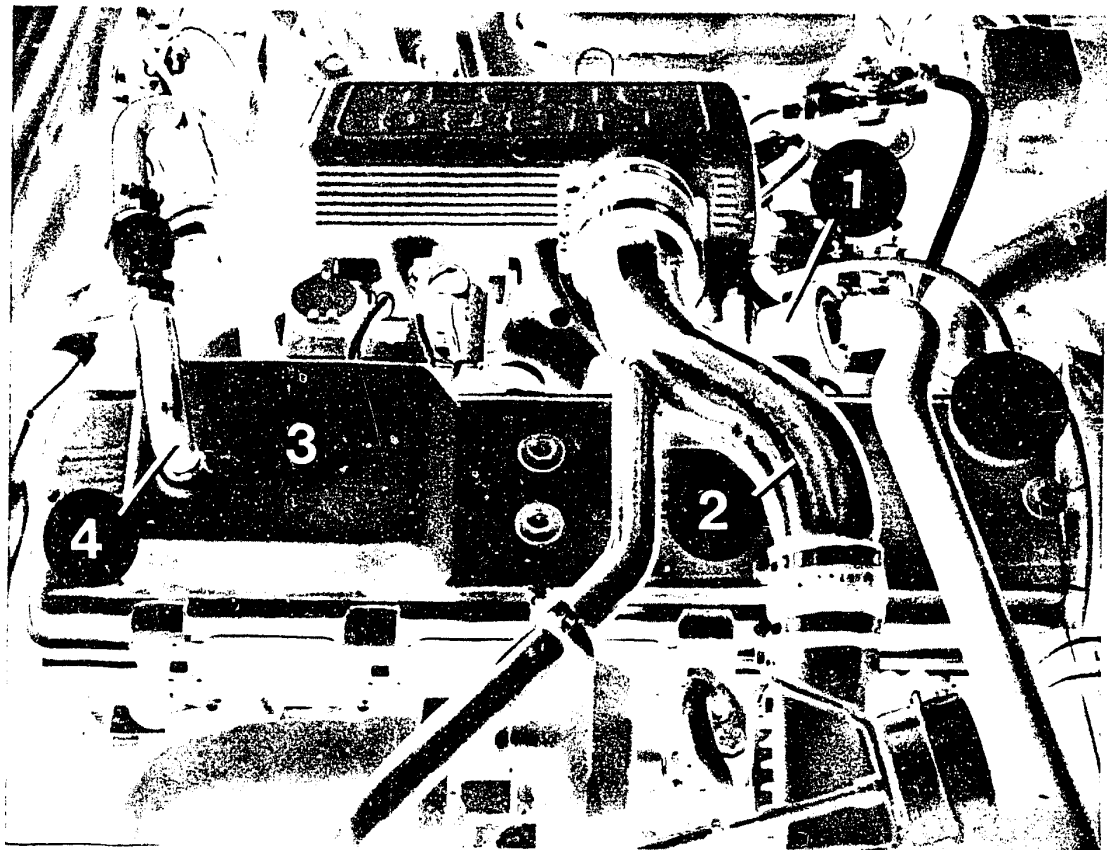


Mount toothed-belt cover (1) and wiring harness (2).  
Mount cooling water hose on water pump and remove hose  
clamer (3).

**L1**

Install and adjust engine timing  
BMW 524 td



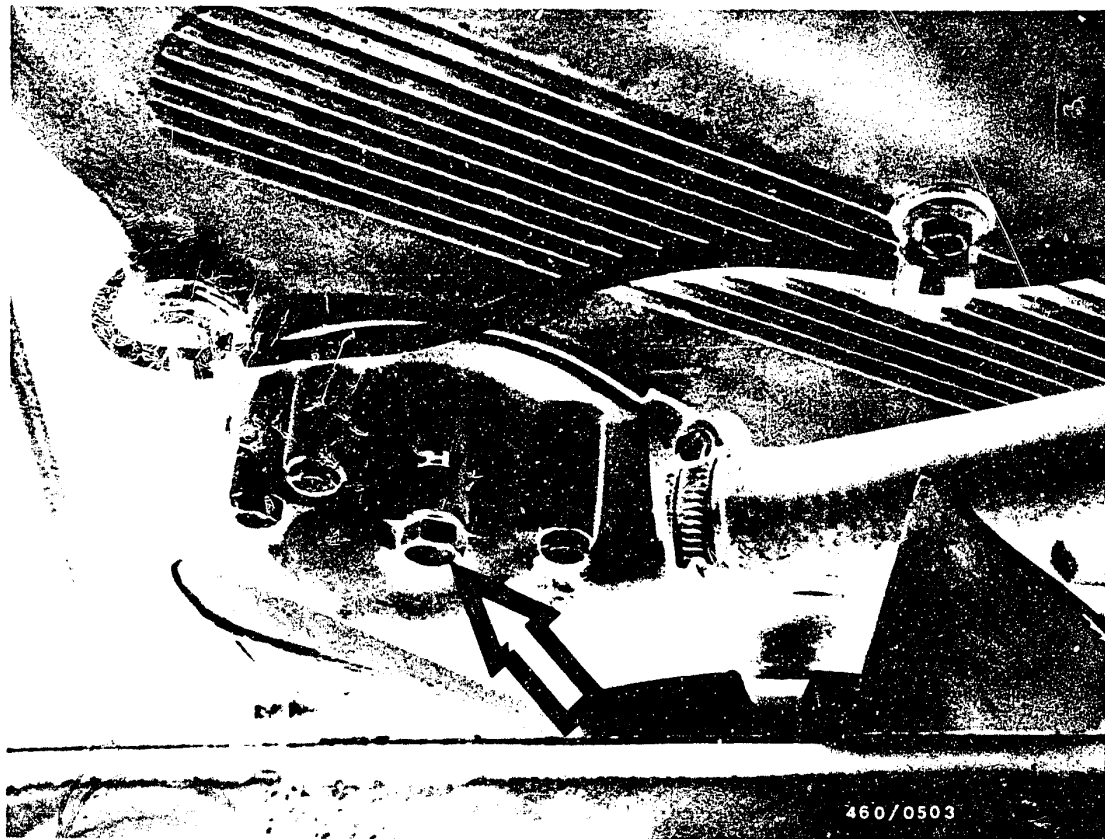


Mount crankcase ventilation pipe (1), connecting pipe between turbocharger and charge-air pipe (2) as well as cylinder head cover (3).

Connect vacuum hose to vacuum pump (4).

Connect negative cable to battery.

Bleeding the fuel system.



- Bleed the cooling system

Fill in coolant up to mark on expansion tank.

Close expansion tank.

Fully open heating control.

Run engine until operating temperature is reached.

Loosen bleeder screw (arrow) on water pump until coolant escapes.

Tighten bleeder screw.

**L3**

Test and adjust engine timing  
BMW 524 td





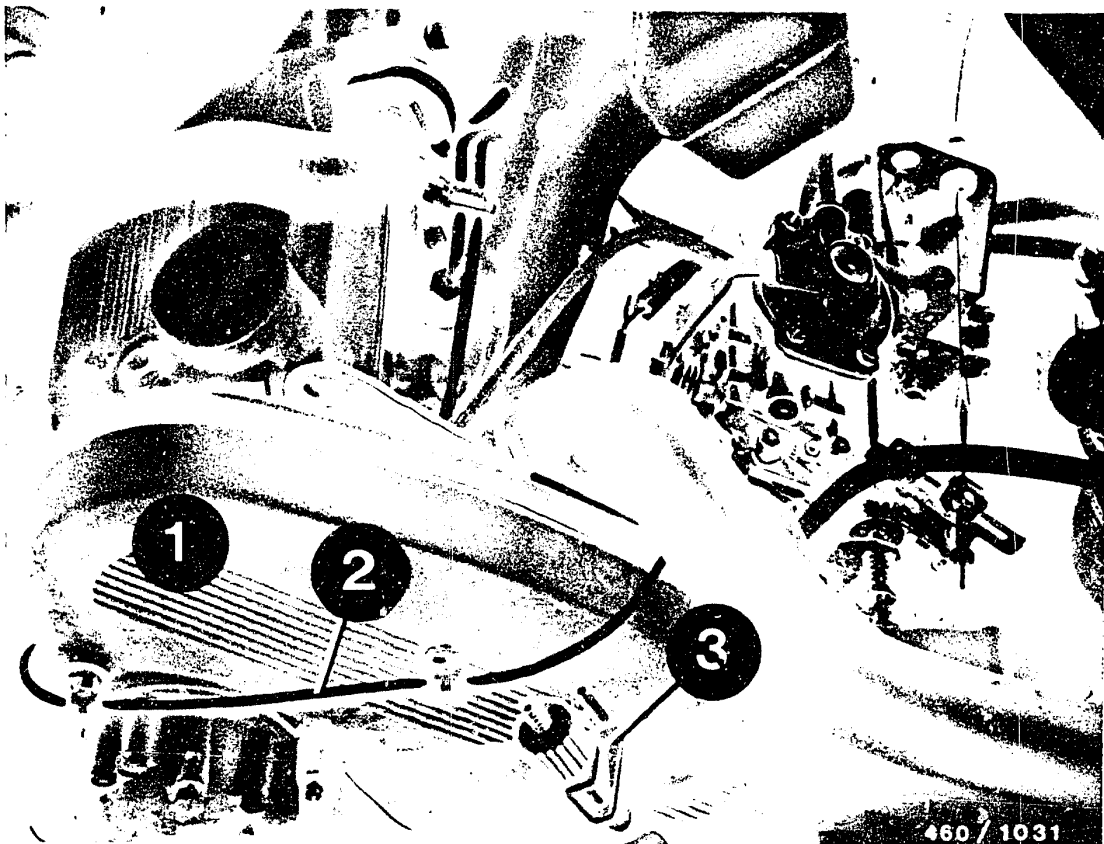
### 37. INJECTION TIMING

Disconnect negative cable from battery.

Turn crankshaft until TDC mark (cylinder 1) on the pulley aligns with reference mark (arrow).

Piston of cylinder 1 is at TDC (valves of cylinder 6 on overlap).





1 = Toothed-belt cover

3 = Hose clammer

2 = Wiring harness

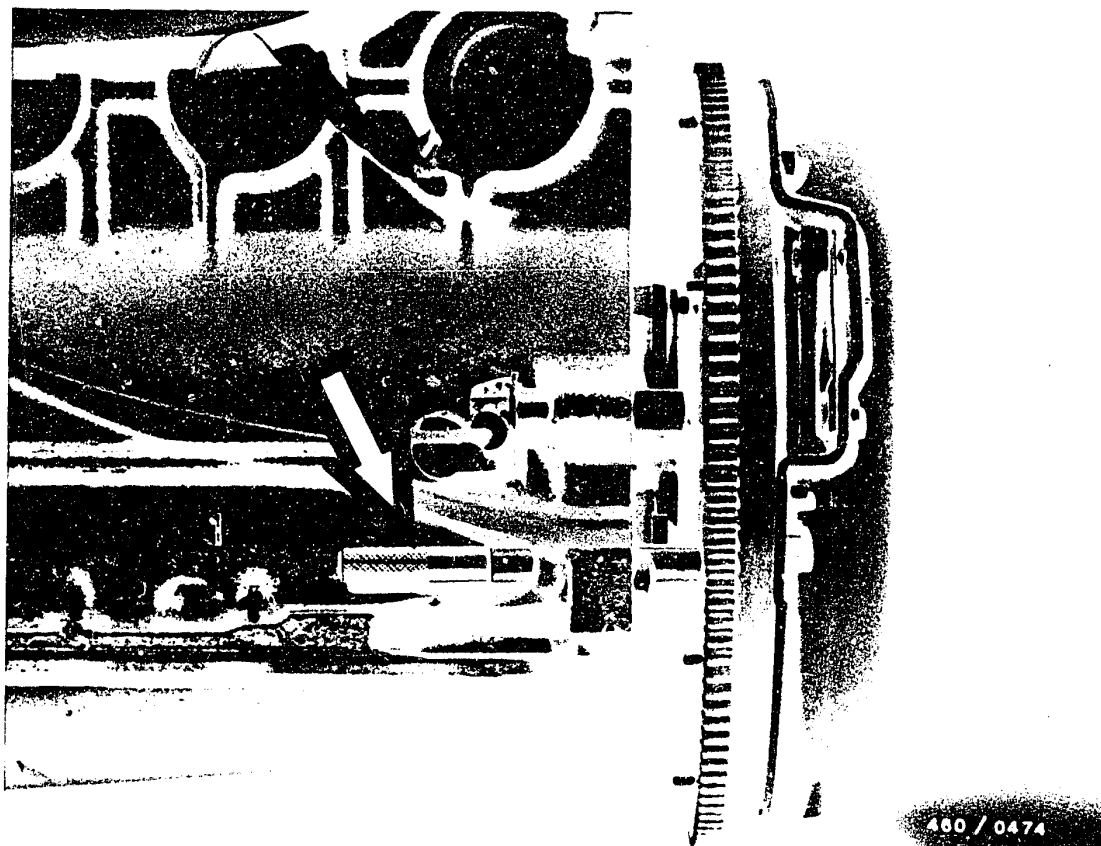
Remove wiring harness (3)

Pinch off cooling-water hose just after water pump using commercially available hose clammers.

Loosen hose clip and pull off cooling water hose.

Catch cooling water.

Remove toothed-belt cover.



Fix the flywheel in place using setting mandrel KDEP 1139 (arrow).

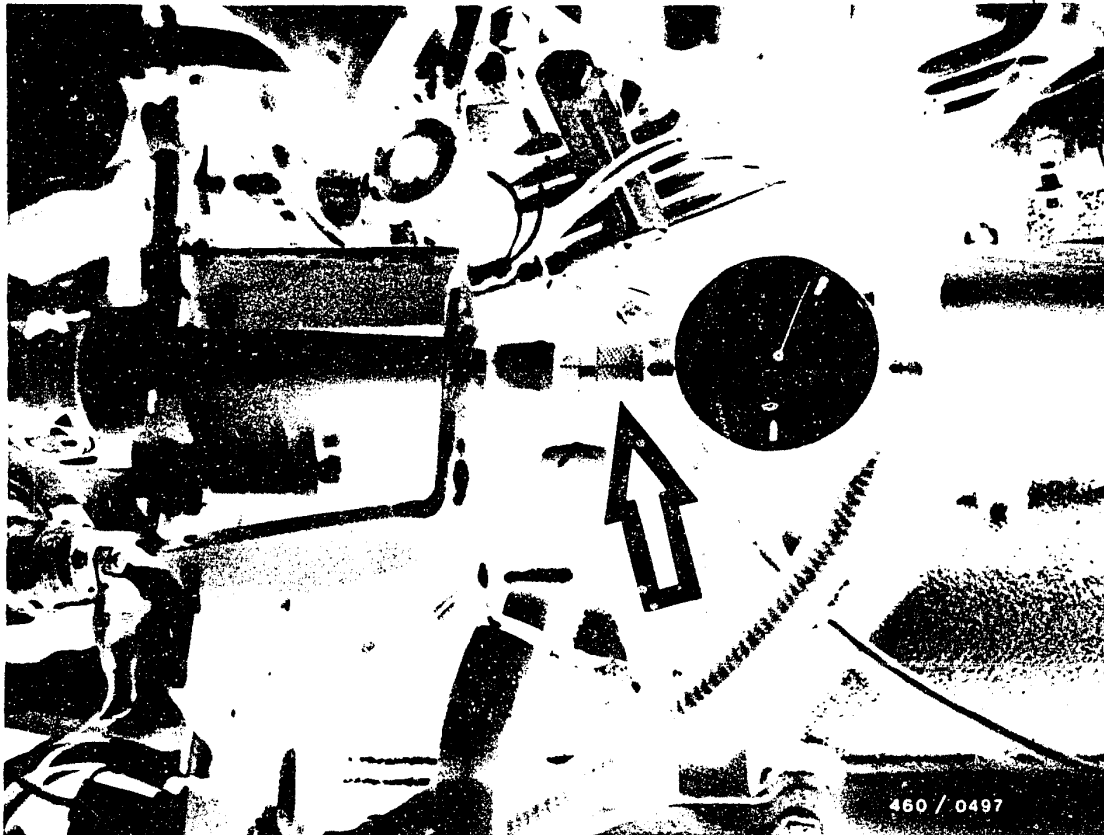
**L6**

Injection timing

BMW 524 td







Remove injection lines from injection pump and from nozzle holders (prevent delivery-valve holders from coming loose by holding with a wrench).

Unscrew bleeder screw from central screw plug (triangular plug) of hydraulic head.

Screw measuring tool KDEP 1085 (arrow) into the tapped hole of the bleeder screw.

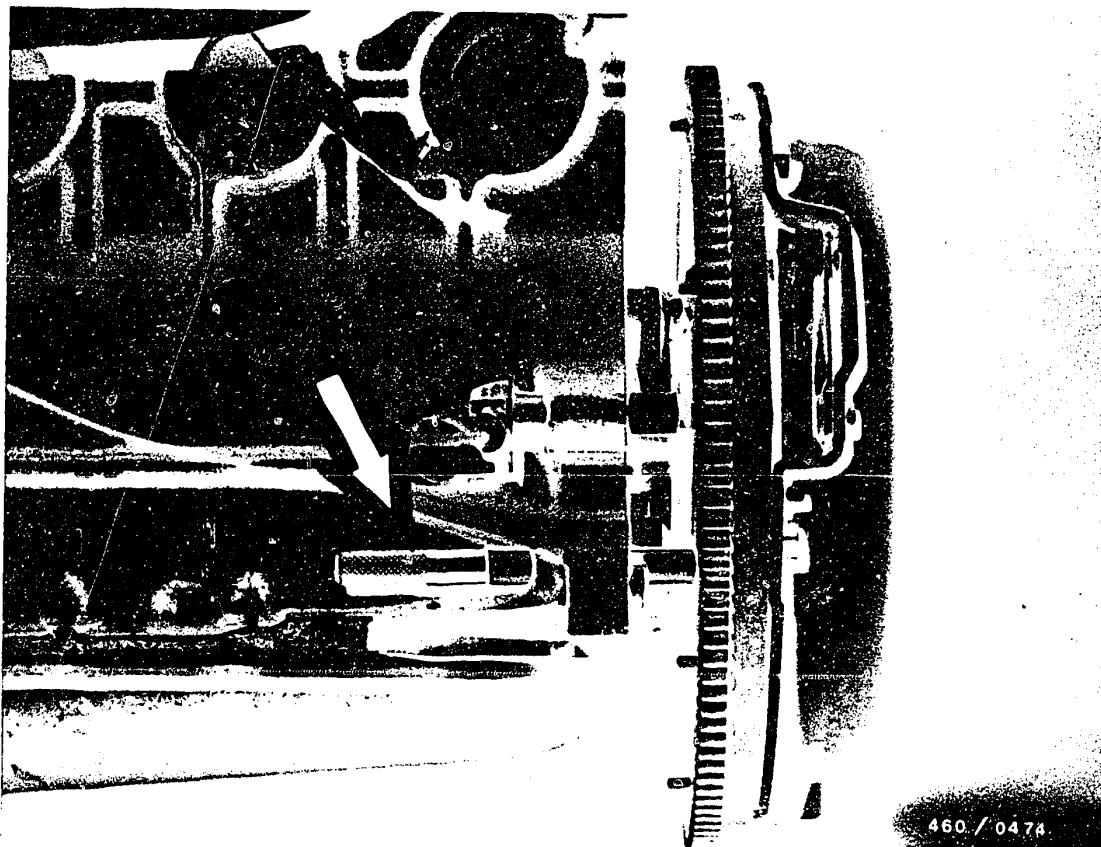
Mount mini dial indicator with measuring insert in measuring tool KDEP 1085.

**L7**

Injection timing

BMW 524 td





Preload dial indicator by approx. 2.5 mm.

Turn crankshaft slowly against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

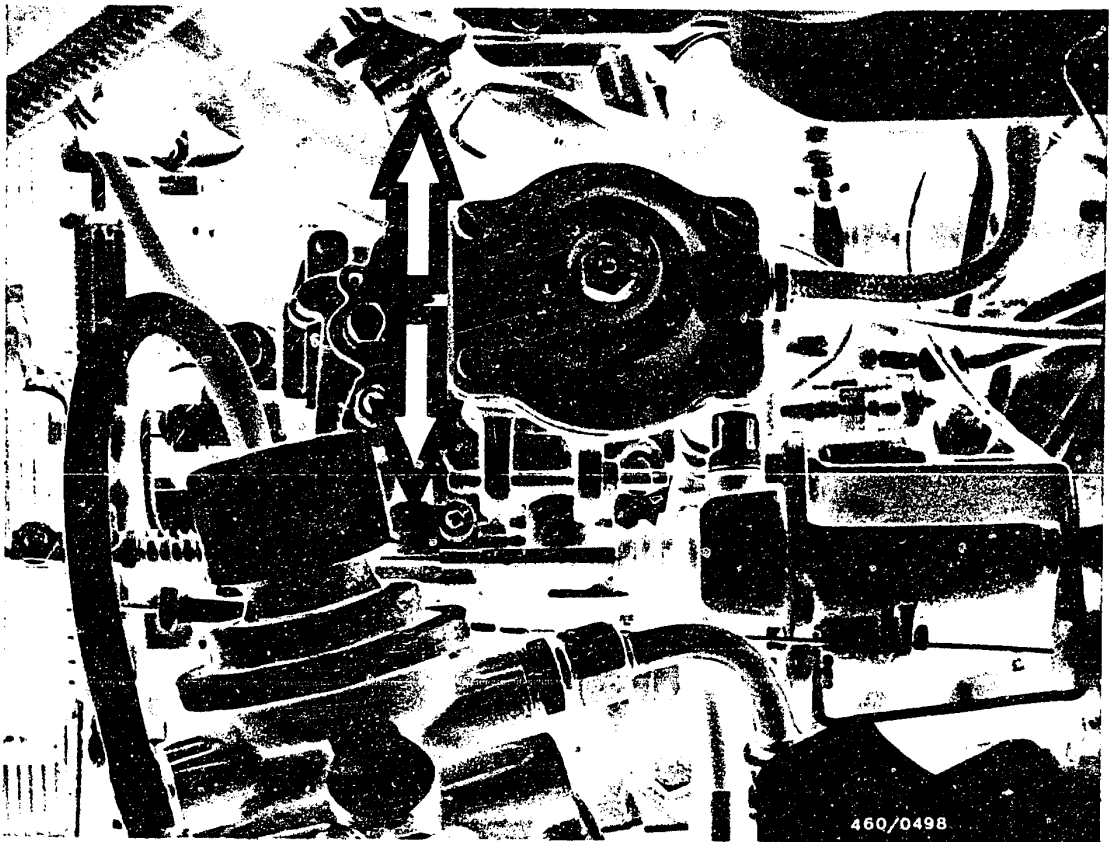
Turn crankshaft in engine direction of rotation until cylinder 1 is at TDC.

Fix the flywheel in place using setting mandrel KDEP 1139 (arrow).

**L8**

Injection timing  
BMW 524 td





In this position, the dial indicator must indicate a stroke of:

0.65 mm ABDC (setting value)

0.61...0.69 mm ABDC (checking value).

If a correction is necessary, loosen injection-pump fastening screws.

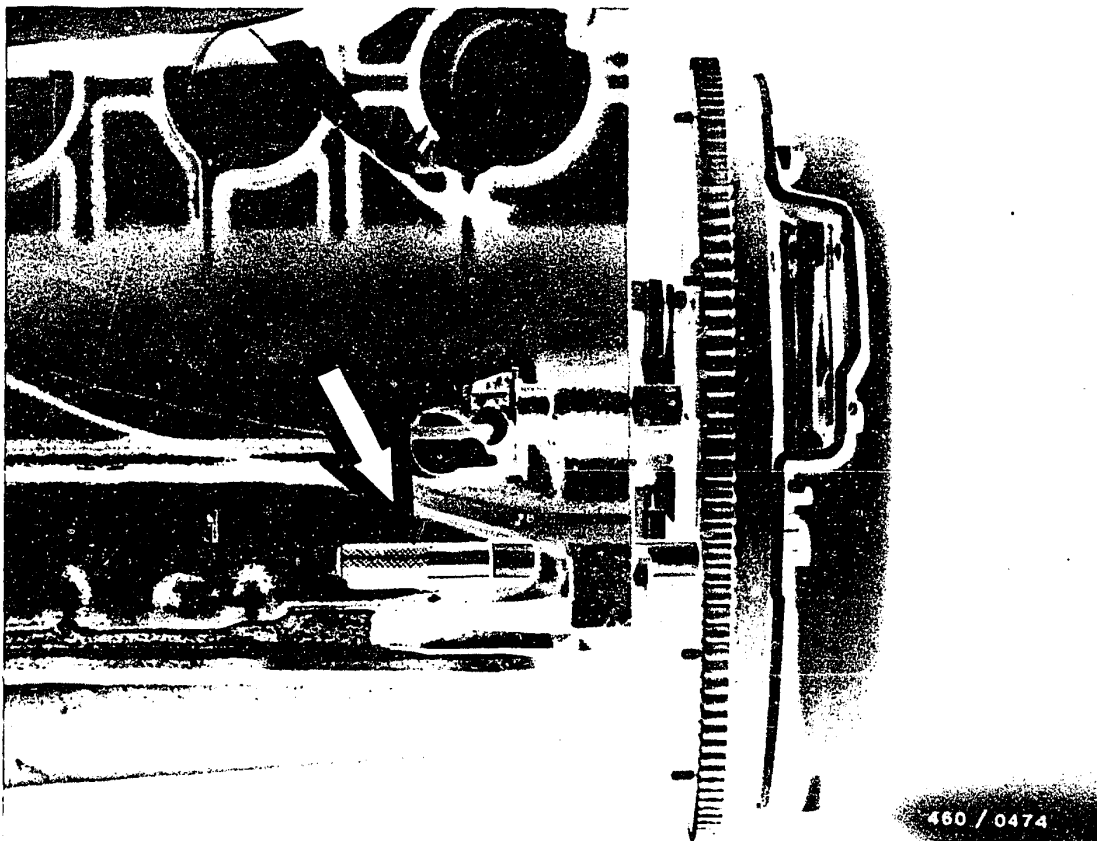
Loosen support bracket.

Pivot injection pump until a stroke of 0.65 mm is obtained.

If reading too small, pivot pump toward engine.

If reading too great, pivot pump away from engine.





Tighten fastening screws of injection pump to 25 Nm.

Remove setting mandrel KDEP 1139.

Turn crankshaft over twice and check setting.

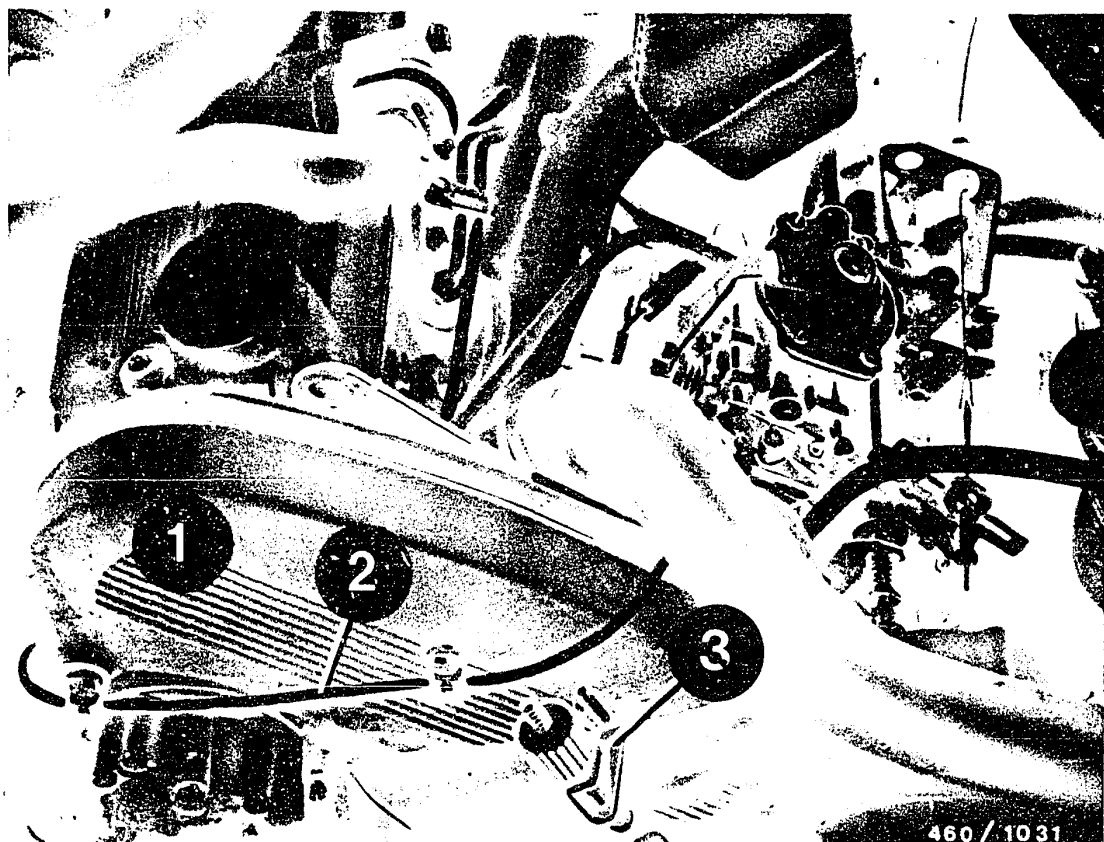
Remove measuring tool KDEP 1085 with dial indicator.

Mount bleeder screw with new seal ring.

Screw down injection pump support bracket with  
20...24 Nm (arrows).

Tighten injection lines with open box wrench KDEP 1115,  
while preventing the delivery-valve holders from turning  
by holding with a wrench.



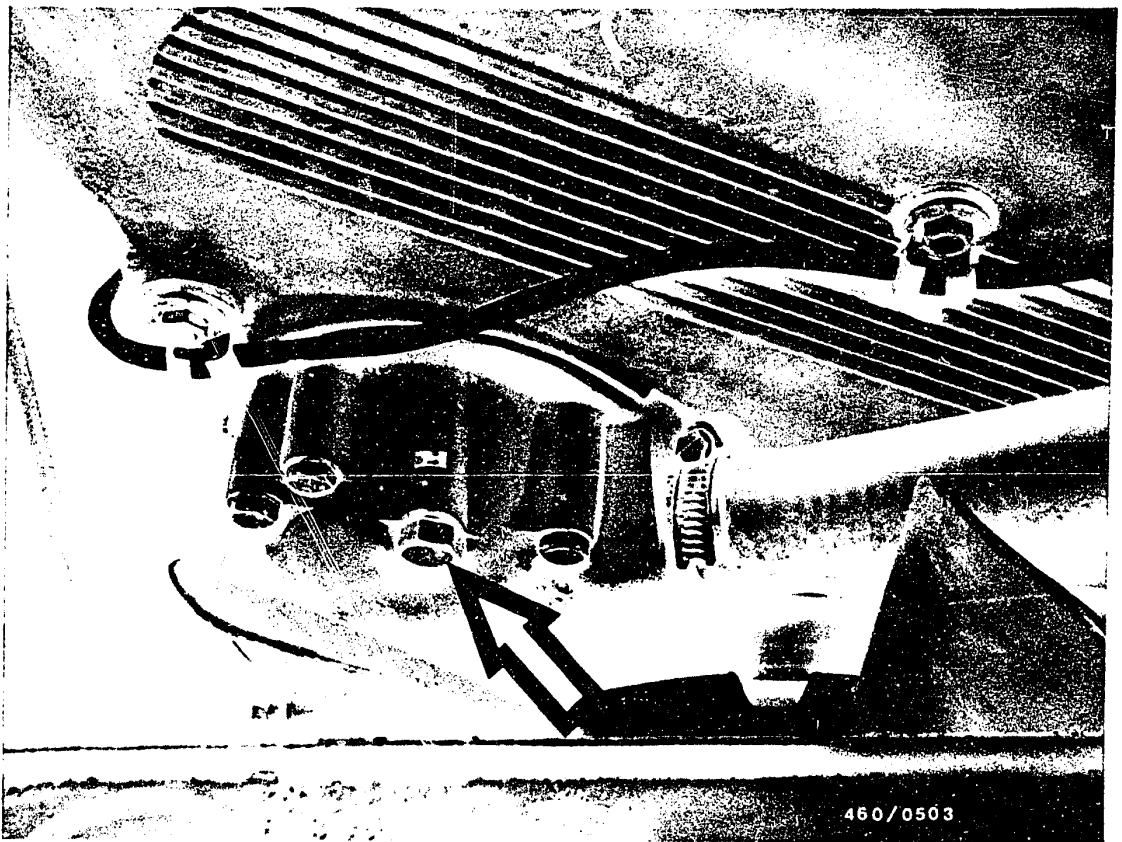


Mount toothed-belt cover (1) and wiring harness (2).

Mount cooling water hose on water pump and remove hose clamber (3).

Connect negative cable to battery.

Bleed fuel system.



- Bleed the cooling system

Fill in coolant up to mark on expansion tank.

Close expansion tank.

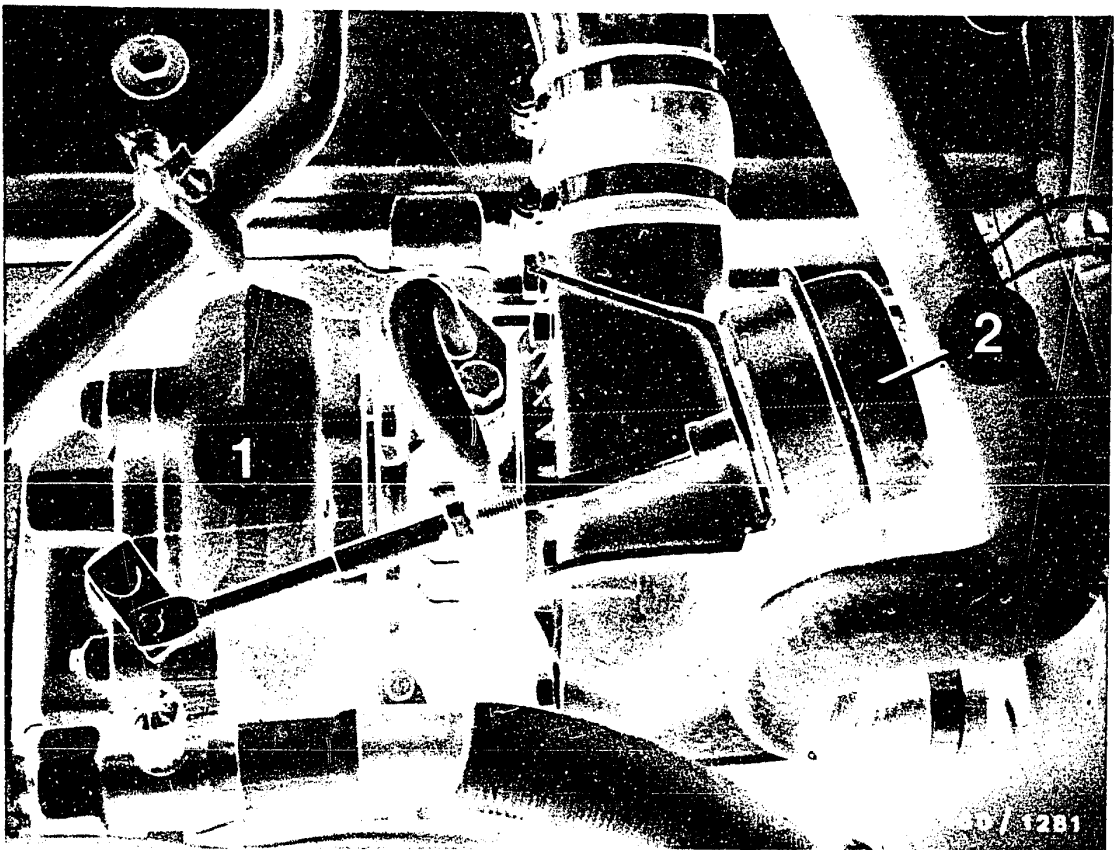
Fully open heating control.

Run engine until operating temperature is reached.

Loosen bleeder screw (arrow) on water pump until coolant escapes.

Tighten bleeder screw.





1 = Turbocharger

2 = Wastegate

### 38. TEST CHARGE-AIR PRESSURE

When working on the turbocharger, it should be noted that even the smallest particles of dirt can lead to the destruction of the turbocharger.

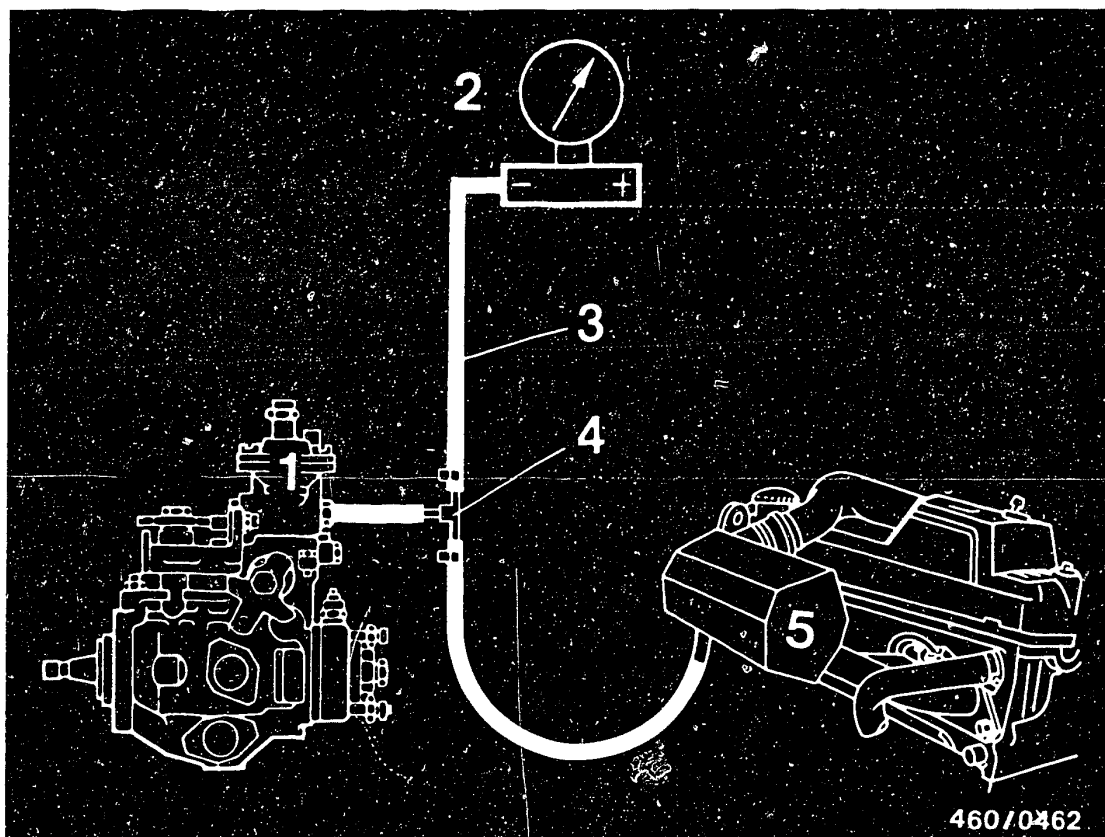
Therefore, never operate the engine without air filter.

#### Caution!

Connecting hose to wastegate must not be removed.

A removed connecting hose can lead to overcharging and to the destruction of the engine at full load.





1 = Atmosphere- and manifold-  
pressure compensator  
(ALDA)

2 = Differential-pressure gauge

3 = Connecting hose

4 = T-piece

5 = Charge-air tube

For testing the charge-air pressure it is possible to use the differential-pressure gauge or the pressure tester KDJE-P 100 with an appropriate connecting-parts set (commercially available).

#### Mounting the differential-pressure gauge

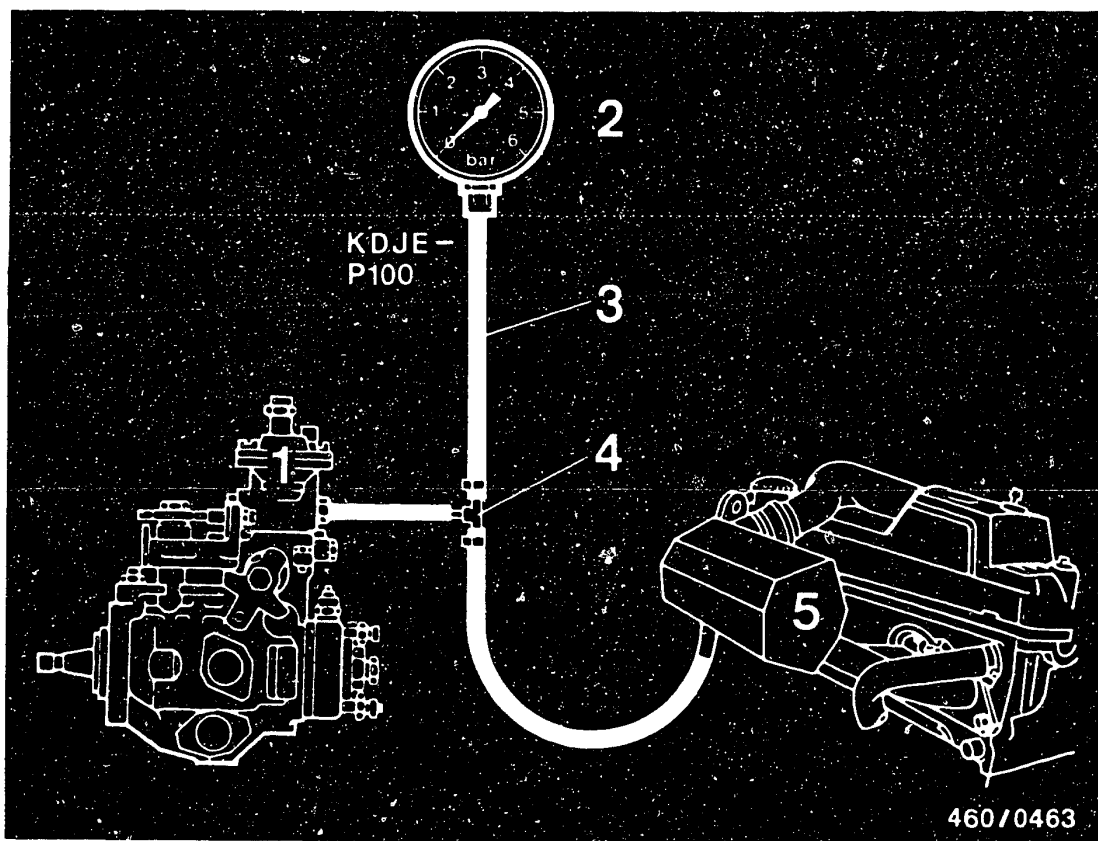
Pull off connecting hose between charge-air tube and injection pump (ALDA-housing) on one side.

Insert connecting hose with T-piece and connect to differential-pressure gauge (+ side).

Engine must be at normal operating temperature for testing.







1 = ALDA  
 2 = Pressure tester  
 3 = Connecting hose

4 = T-piece  
 5 = Charge-air tube

#### Mounting the pressure tester (KDJE-P 100)

Pull off connecting hose between charge-air tube and injection pump (ALDA-housing) on one side.

Insert connecting hose with T-piece and connect to pressure tester.

### 38.1 Measuring the charge-air pressure

The charge-air pressure is measured under full load, if possible on chassis dynamometer or on road, as of approx. 2500 min<sup>-1</sup>.

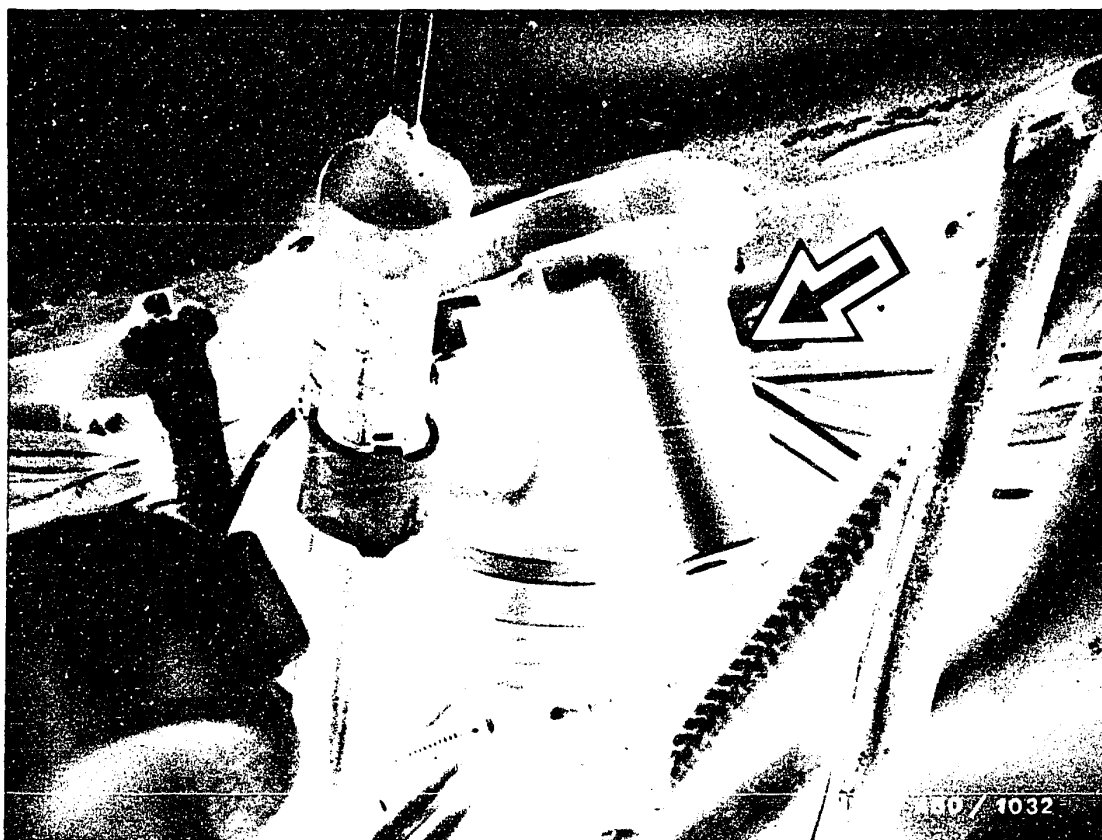
Read off charge-air pressure on pressure gauge.

Specification: 0.75 ... 0.85 bar

#### Note:

To assess the turbocharger, it is essential that the start of delivery and the nozzle-opening pressure have been correctly adjusted, that there are no leaks on the intake or exhaust sides, and that the engine is in good mechanical condition (valve clearance, compression pressure).





### 38.2 Test charge-air pressure blow-off valve

A charge-air pressure blow-off valve (arrow) is built into the charge-air pipe.

This opens whenever the charge-air pressure exceeds 0.95...1.05 bar.

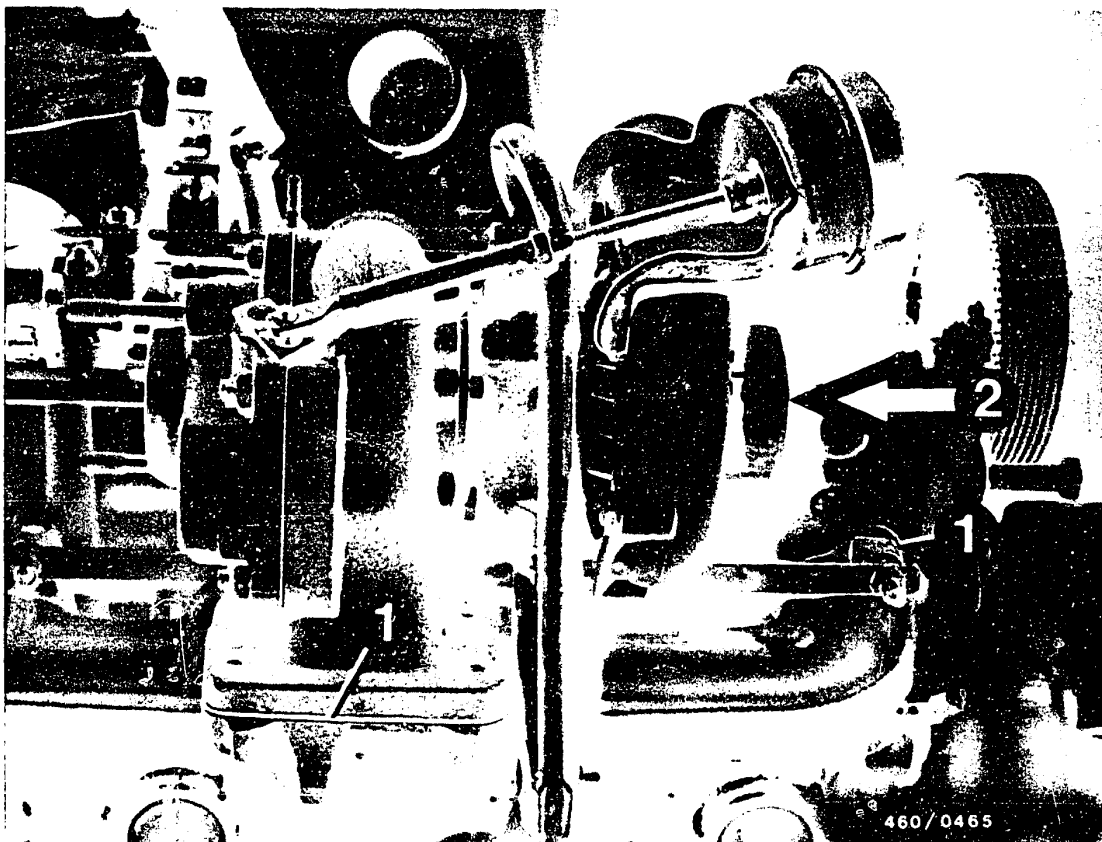
During the blow-off process, a contact in the valve is closed and the oil-pressure warning lamp is triggered.

#### Note:

The oil-pressure warning lamp has two functions:

1. Warning lamp if the oil pressure is too low.
2. Charge-air pressure indicator if the charge-air pressure is too high.





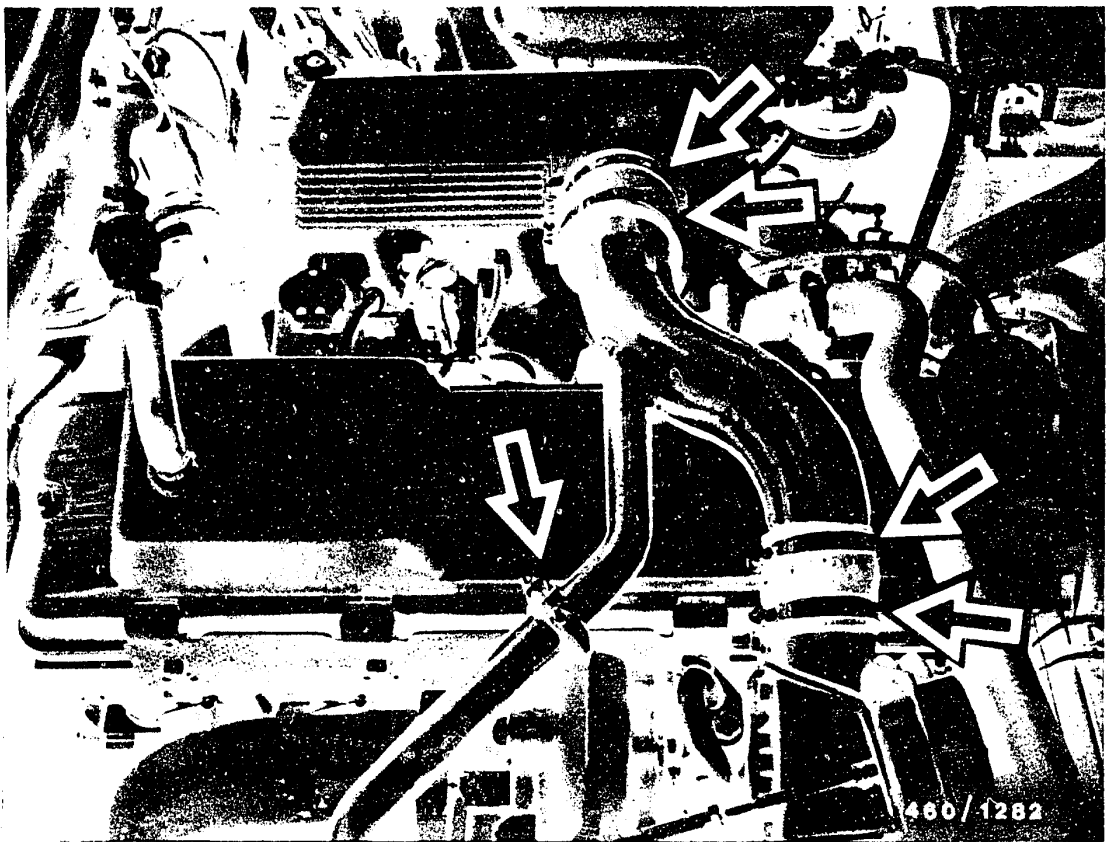
- 1 = Exhaust manifold flange gasket  
2 = Turbine inlet

### 38.3 Test turbocharger for leaks

If there are deviations (low charge-air pressure) check the following places for leaks:

- Exhaust manifold flange gasket
- Turbine inlet hose clamp



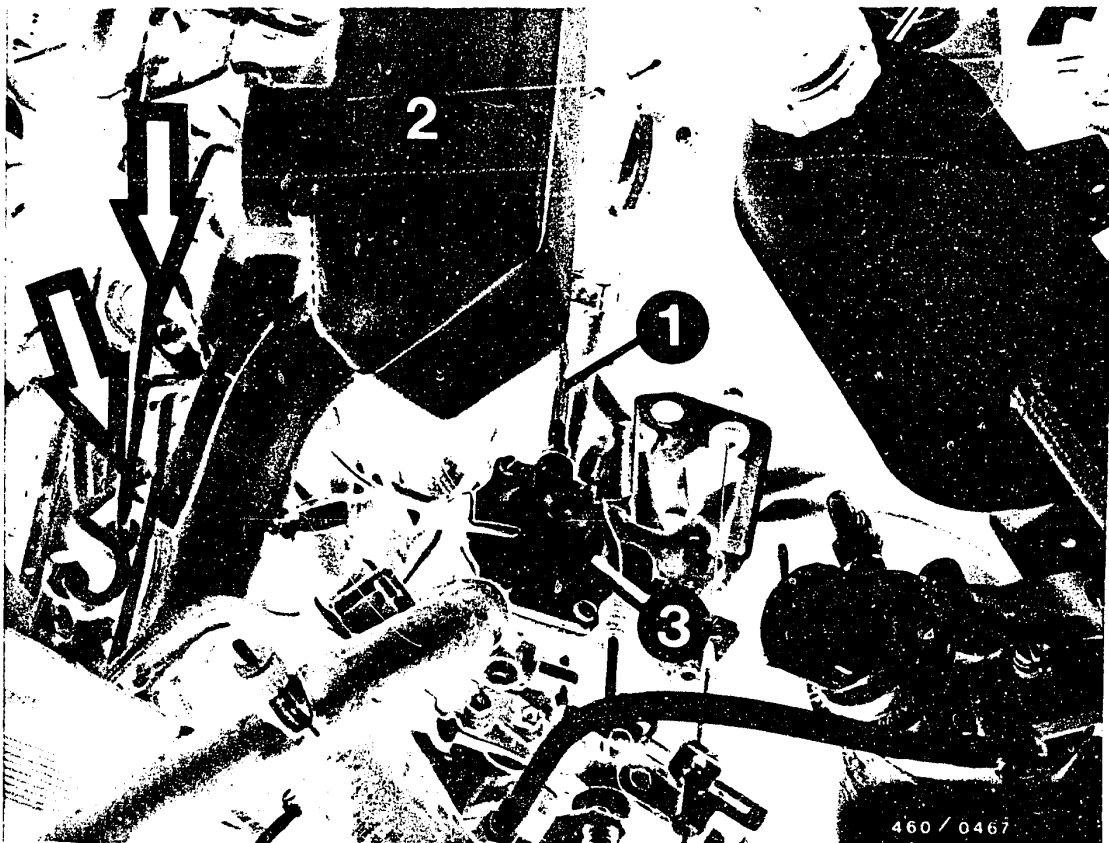


- Connecting pipe between compressor outlet and charge-air pipe (arrows).

**L19**

Test charge-air pressure  
BMW 524 td





- Connecting hose (1) between charge-air tube and injection pump (ALDA-housing).
- Seal between charge-air tube (2) and engine block (arrows).
- Diaphragm in ALDA (3)

Additional causes for too low a charge-air pressure:

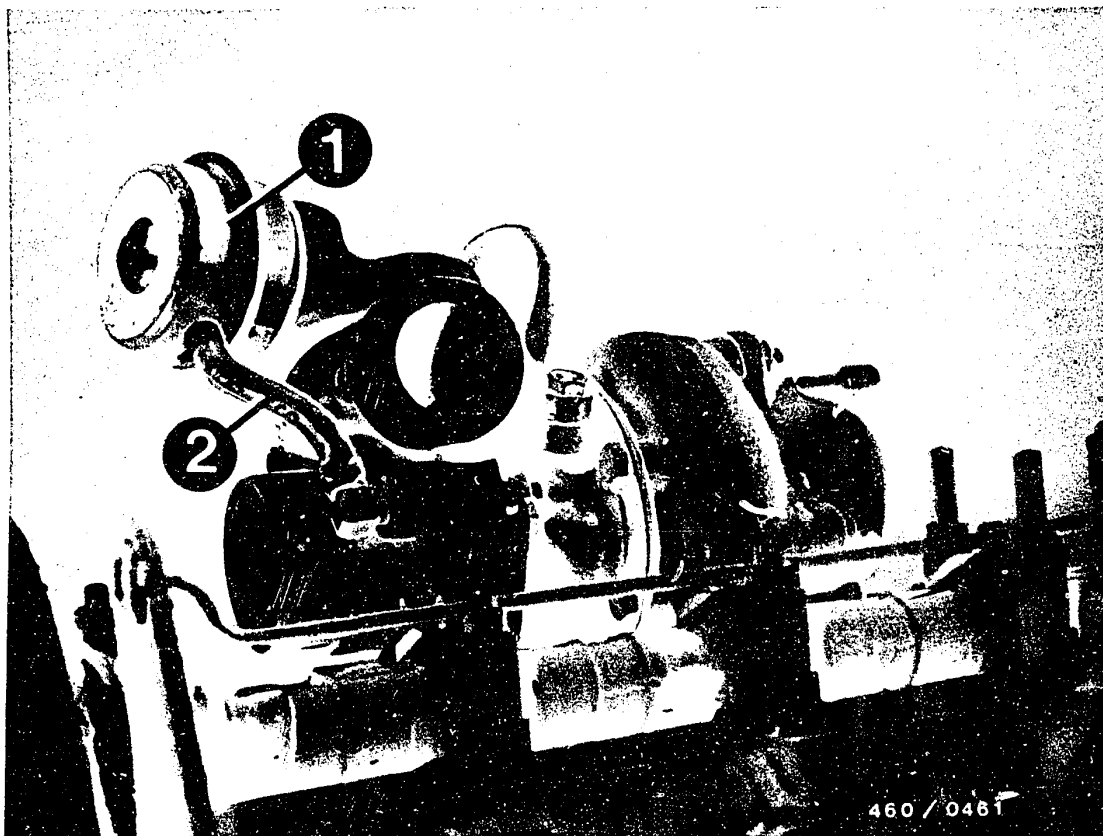
- Air filter (fouled).
- Wastegate incorrectly set.
- Turbine shaft tends to seize \*.
- Exhaust system clogged.

\* = replace the exhaust gas turbocharger.

Note:

After mounting a new exhaust gas turbocharger, fill the charger with oil and run the engine for approx. 1 minute at idle so as to ensure the oil supply to the charger.





1 = Wastegate

2 = Connection hose

Possible causes for too high a charge-air pressure (above 1.0 bar):

- Check the connection hose (2) from the compressor housing to the wastegate. If there are leaks or if the connection hose is pinched off, take it out and replace it.
- The diaphragm of the wastegate is defective (\*)
- The valve of the wastegate has jammed shut (\*) and replace the wastegate.
- The valve for the wastegate is incorrectly set.

\* = replace wastegate

Note:

Before taking out and replacing the wastegate, check the axial and radial clearances of the exhaust gas turbocharger acc. to manufacturer info.

**L21**

Test charge-air pressure  
BMW 524 td.



## 39. TEST EXHAUST-GAS RECIRCULATION SYSTEM

### 39.1 Operating principle

Some of the exhaust gas is recirculated to the intake manifold through a vacuum-controlled exhaust-gas recirculation valve (EGR valve).

This afterburning of a part of the exhaust gas reduces the combustion temperature and the emission of nitrogen oxides ( $\text{NO}_x$ ).

The EGR rate is adapted to the variations in the quantity of fuel injected by constant adjustment of the control vacuum in a mechanical-pneumatic pressure transformer. This pressure transformer is connected to the control lever of the injection pump (load signal).

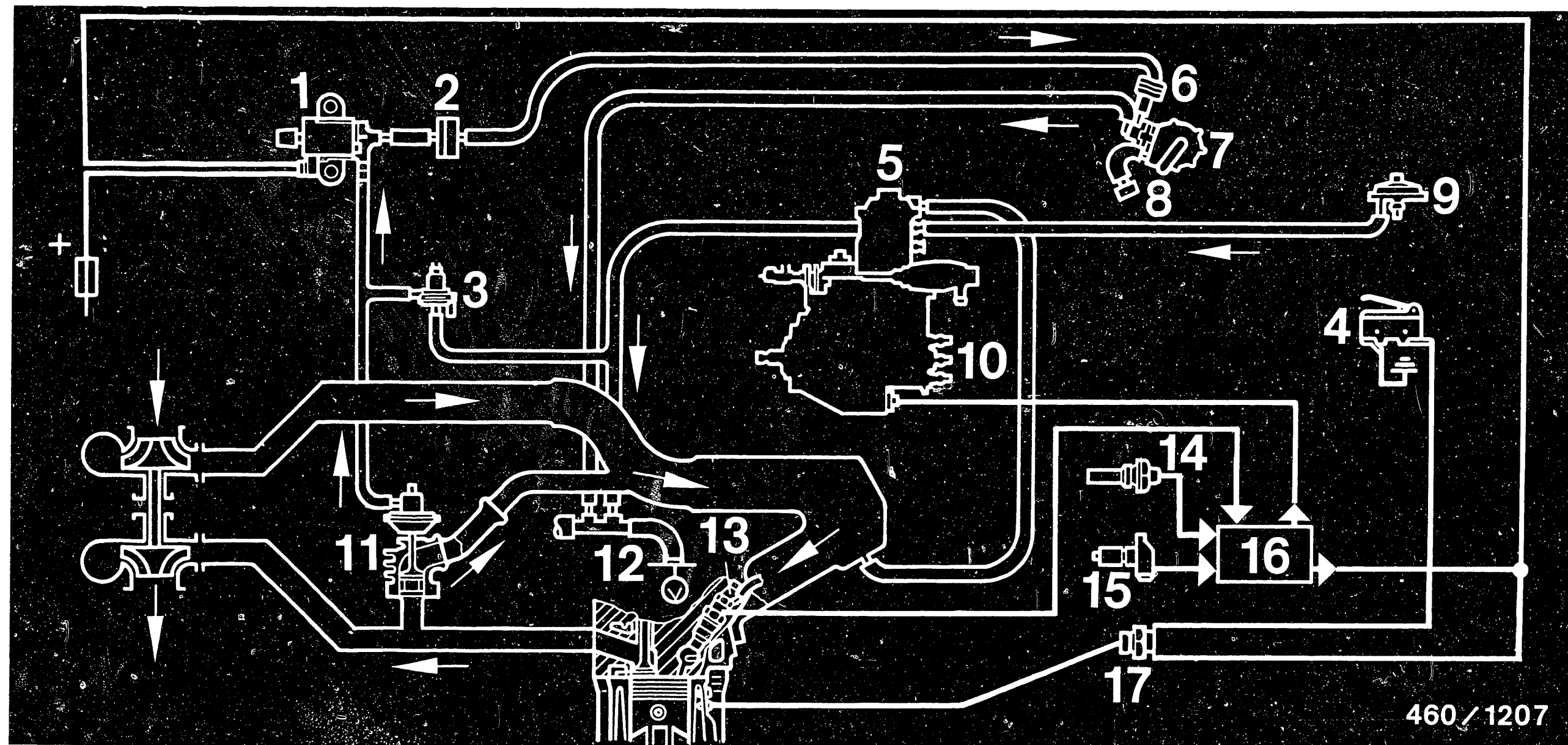
The working range of the exhaust-gas recirculation system is limited to the operating conditions of idle and part load by an electromagnetic change-over valve (Item No. 1 in the following system circuit diagram).

- Idle ( $750 \dots 800 \text{ min}^{-1}$ )  
at coolant temperature  $> 78^\circ\text{C}$
- Part load between  $1000 \dots 2800 \text{ min}^{-1}$   
at coolant temperature  $> 78^\circ\text{C}$

When the engine is cold or at full load, the exhaust-gas recirculation system is inoperative.







460 / 1207

- |  |                             |                               |
|--|-----------------------------|-------------------------------|
| 1 = Change-over valve                                  | 6 = Damper                  | 12 = Vacuum pump              |
| 2 = Restriction  | 7 = Pressure transformer    | 13 = Needle-movement sensor   |
| 3 = ALDA air valve                                     | 8 = Filter                  | 14 = Temperature sensor       |
| 4 = Microswitch  | 9 = Reference pressure unit | 15 = Engine-speed sensor      |
| 5 = Altitude- and manifold-pressure compensator (ALDA) | 10 = Timing valve           | 16 = Control unit             |
|  | 11 = EGR valve              | 17 = Water-temperature sensor |

39.2 System circuit diagram of exhaust-gas recirculation

**M2**

Test EGR system

BMW 524 td

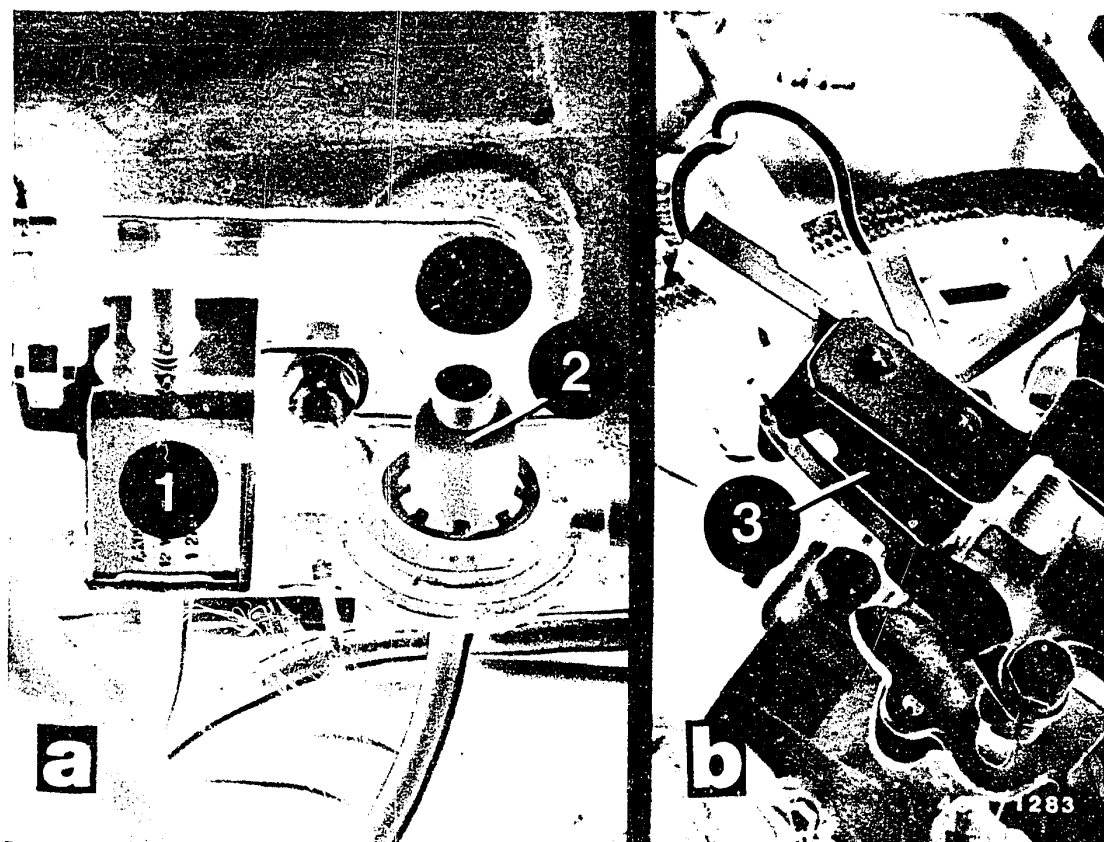


**M3**

Test EGR system

BMW 524 td





The electromagnetic change-over valve (1) is energized at idle by a closed microswitch (3) which opens when the control lever is actuated by 0.5 mm (measured between control lever and idle stop screw), thereby switching off the exhaust-gas recirculation.

The ALDA\* air valve (2) additionally admits air to the vacuum line to the ALDA when there is a pressure difference  $> 290$  mbar between change-over valve/EGR valve and vacuum pump (engine) /ALDA.

This reduces the full-load delivery and, depending on the degree of loading of the engine, prevents black smoke.

\* ALDA = Atmospheric and manifold-pressure compensator



At part load between  $1000 \text{ min}^{-1}$  (setting point) and  $2800 \text{ min}^{-1}$  (switch-off point) the control unit (picture) takes over the energization of the electromagnetic change-over valve.

**M5**

Test EGR system  
BMW 524 td



### 39.3 Test exhaust-gas recirculation system

#### Test conditions:

- Idle speed 750...800 min<sup>-1</sup>
- Coolant temperature > 78°C.
- Ground connection at idle switch O.K.

Test idle actuator (top picture-arrow)  
Disconnect plug.  
Test switch for continuity with multimeter.  
O.K.?

no

1. Check opening point of 0.5 mm between idle stop screw and control lever.
2. Replace idle switch.

yes

Test thermo-switch  
(center picture-arrow)  
Disconnect plug.  
Test switch for continuity with multimeter.  
O.K.?

no

1. Coolant temperature > 78°C
2. Replace thermo-switch (arrow)

yes

Test pressure transformer (bottom picture)

#### Test conditions:

Control lever up against idle stop.  
Connect vacuum pump (engine) to port "A" (black-red connecting hose) and vacuum test to port "B" (black-blue connecting hose).

Slide feeler gauge KDEP 1142 (1) over EGR coupling part (2) and fix in web of manifold-pressure compensator housing (arrow) by turning control lever (3).

Inlet pressure at port "A" min. 550 mbar.

Setting pressure at port "B": 357... 363 mbar.

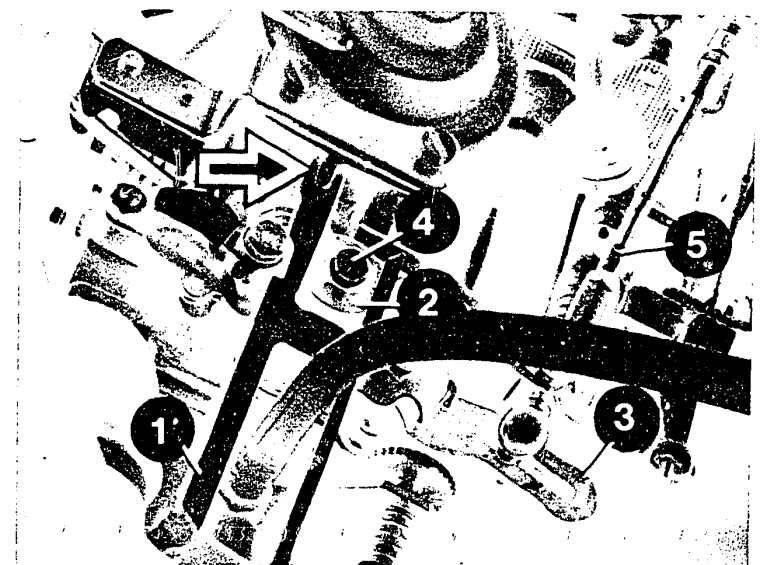
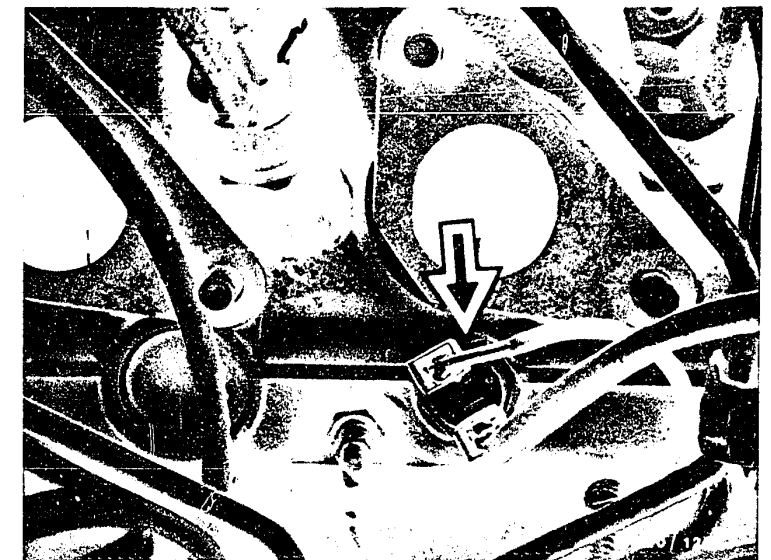
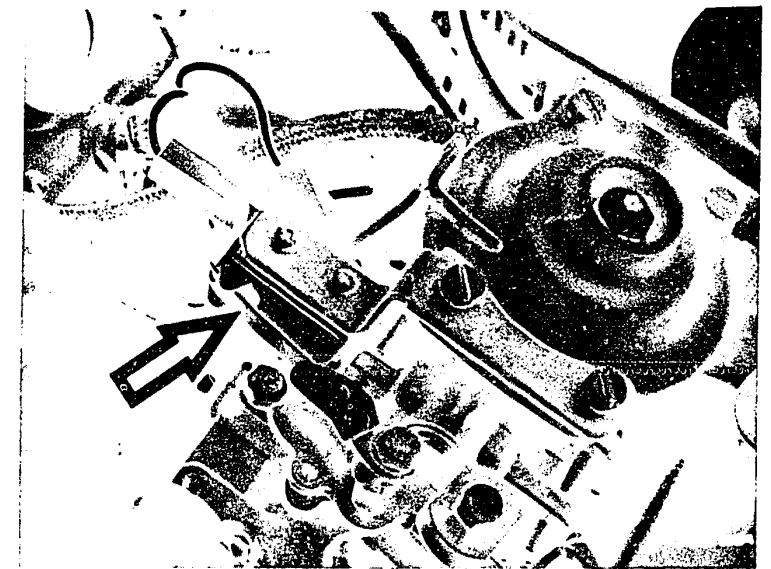
Checking pressure at port "B": 350... 370 mbar.

Vacuum values obtained?

no

1. Inlet pressure < 550 mbar?
  - Check vacuum hoses for leaks and/or pinching.
  - Check vacuum pump (engine) for proper operation, and replace if necessary.
2. Setting pressure tolerance not obtained?
  - Adjust connecting rod (5).

yes



M6

Test EGR system  
BMW 524 td



M7

Test EGR system  
BMW 524 td



### Electrical test of change-over valve

#### Test conditions:

- Positive connection to change-over valve O.K.
- Disconnect plug.

Test change-over valve for continuity with multimeter.  
O.K.?

no

Replace change-over valve (1).

yes

### Pneumatic test of change-over valve

Connect disconnected plugs. Disconnect vacuum line to EGR valve on change-over valve and connect vacuum tester.

At a coolant temperature of  $> 78^{\circ}\text{C}$ , check change-over valve for pneumatic continuity at idle  $750\ldots 800\text{ min}^{-1}$  and in the engine-speed range between  $1000$  and  $2800\text{ min}^{-1}$ .

O.K.?

no

Replace change-over valve (1).

yes

### Check EGR valve

With vacuum applied, disconnect hose line.

The valve plate must impact audibly on the valve seat ring.

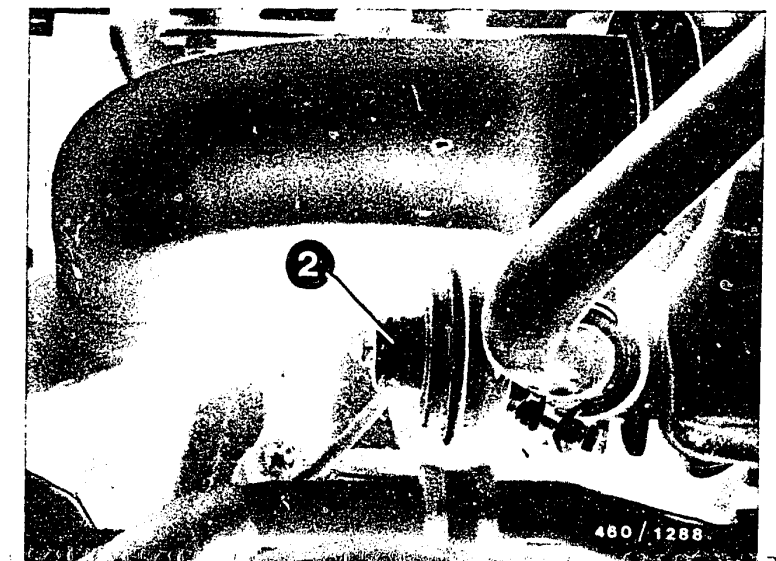
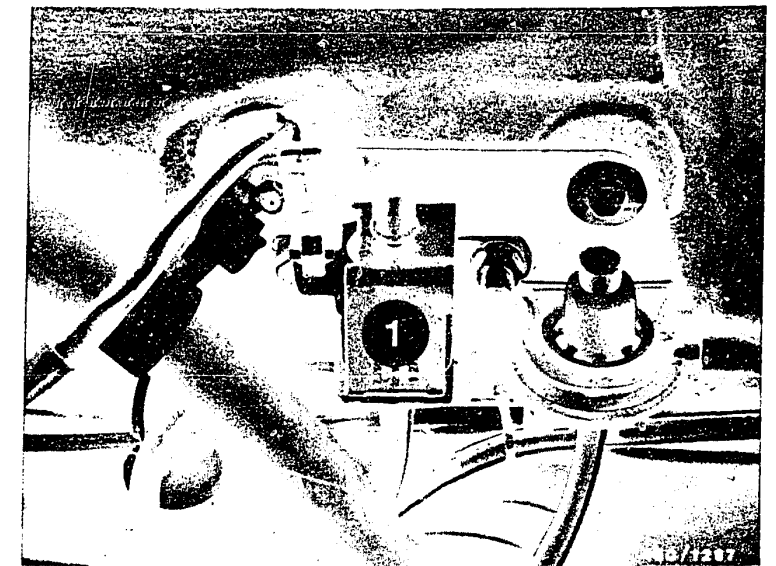
Does valve close?

no

Replace EGR valve (2).

yes

Exhaust-gas recirculation system O.K.



**M8**

Test EGR system  
BMW 524 td



**M9**

Test EGR system  
BMW 524 td



# Motor Vehicle Service Information

Only for use within the Bosch organization. No to be communicated to any third party.

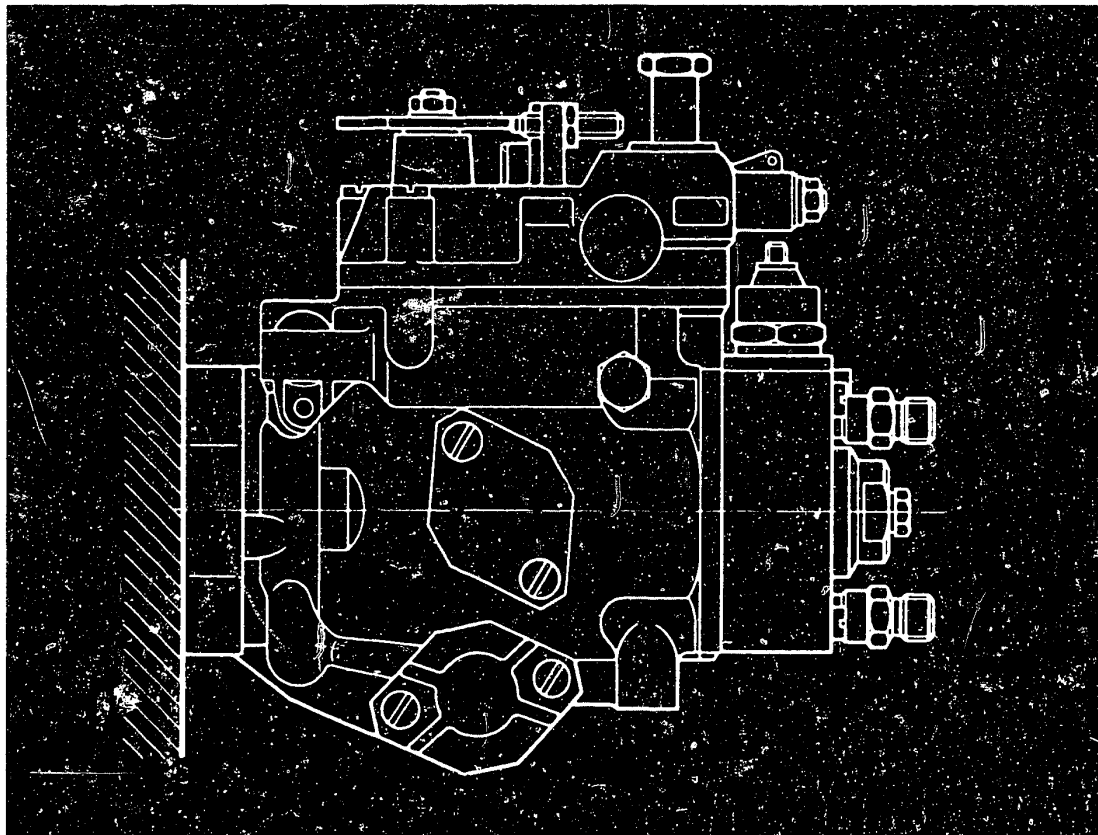
Fuel-injection equipment

BLEEDING OF DISTRIBUTOR-TYPE  
FUEL-INJECTION PUMPS VE..F..

VDT-I-Gen. 069 En

11.1984

supersedes I-460/120 of 1.81



If distributor-type fuel-injection pumps are mounted on the engine, always fill injection pump and fuel filter with fuel.

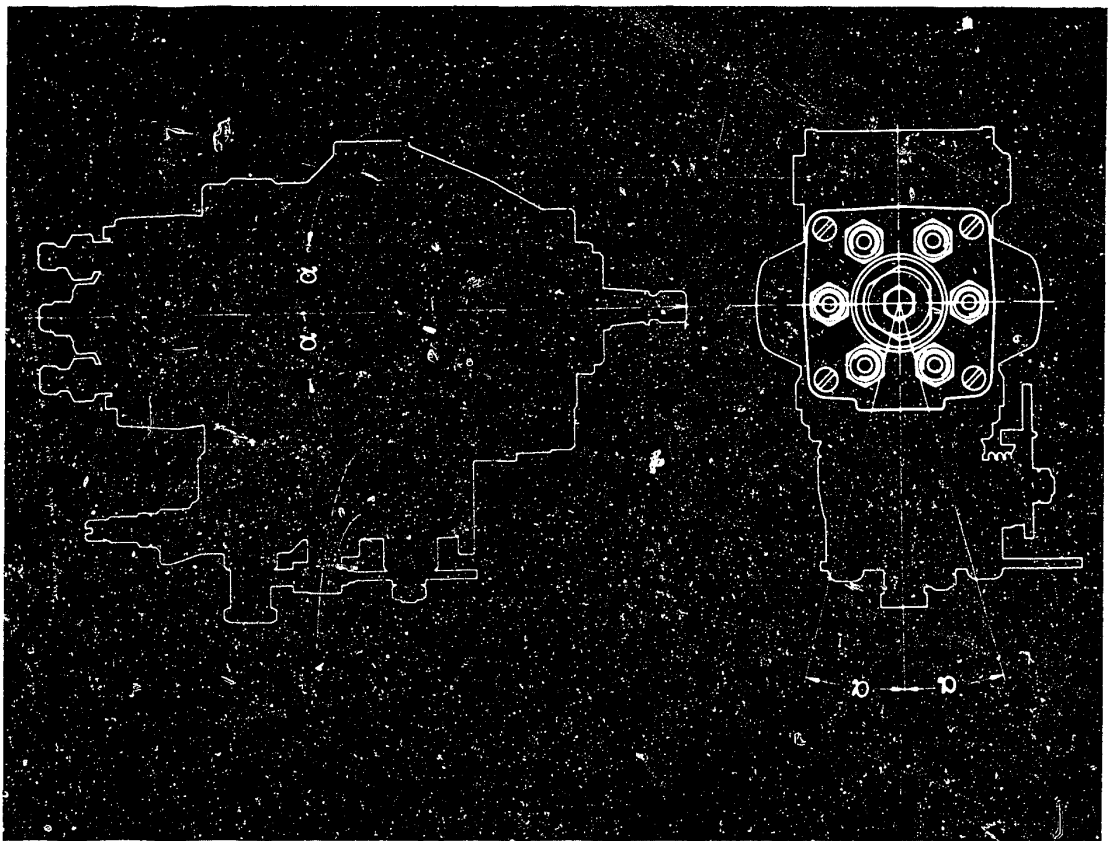
Horizontally (see picture) mounted distributor-type fuel-injection pumps do not need to be bled since the fuel overflow forms the highest point on the distributor-type pump, and the air in the distributor-type pump is forced back to the tank.

**N1**

Motor Vehicle Service Information

BMW 524 td

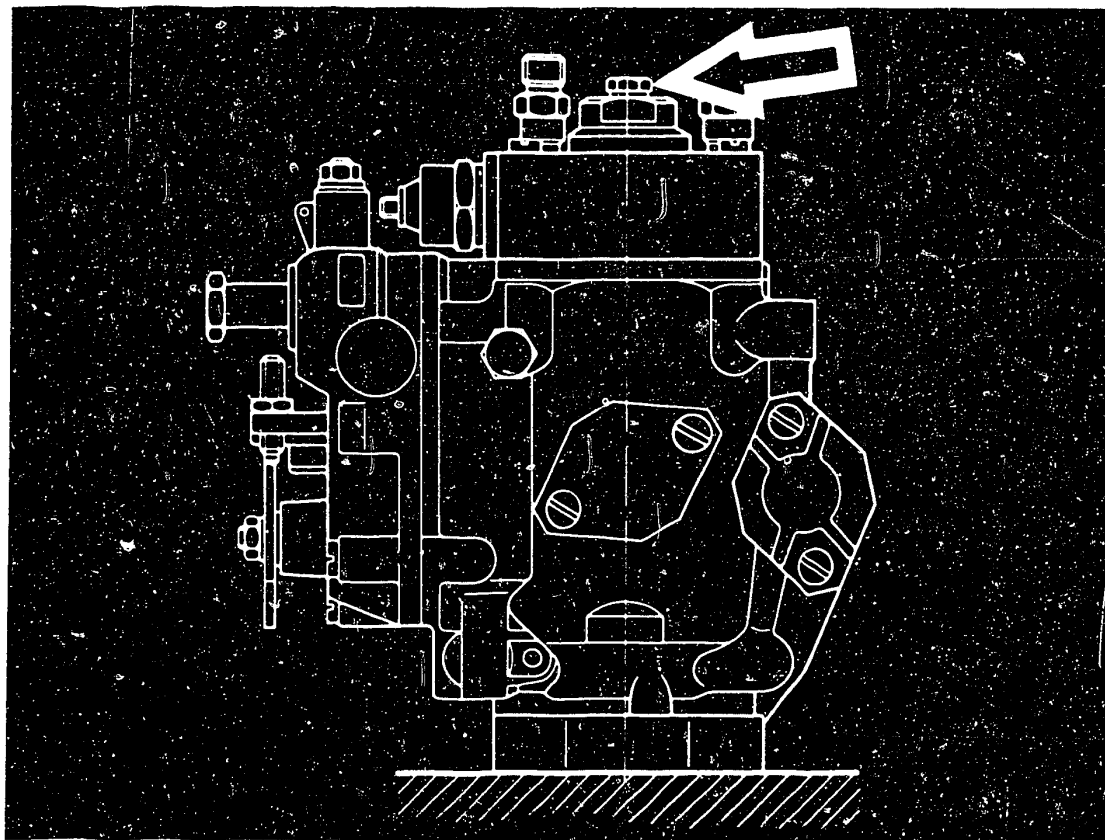




$a$  = Angle of inclination

If the installation position differs by more than  $45^\circ$  (see picture) from the horizontal, then in most cases it will be necessary to bleed the distributor-type fuel-injection pump.



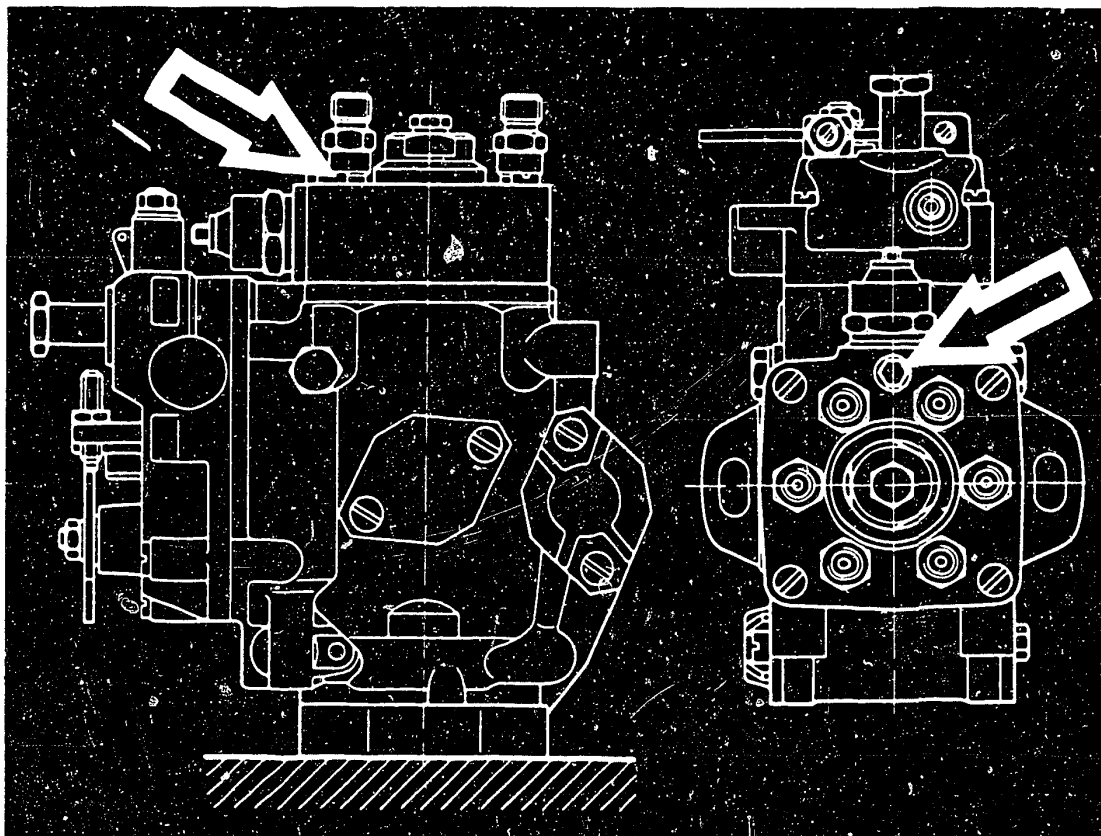


### 1. Vertical installation

To bleed vertically installed distributor-type fuel-injection pumps, open hexagon screw in central screw plug of hydraulic head (see picture, arrow) until flat place on thread becomes visible. Operate starting motor until fuel escaping at this point is free of bubbles; then re-tighten hexagon screw.



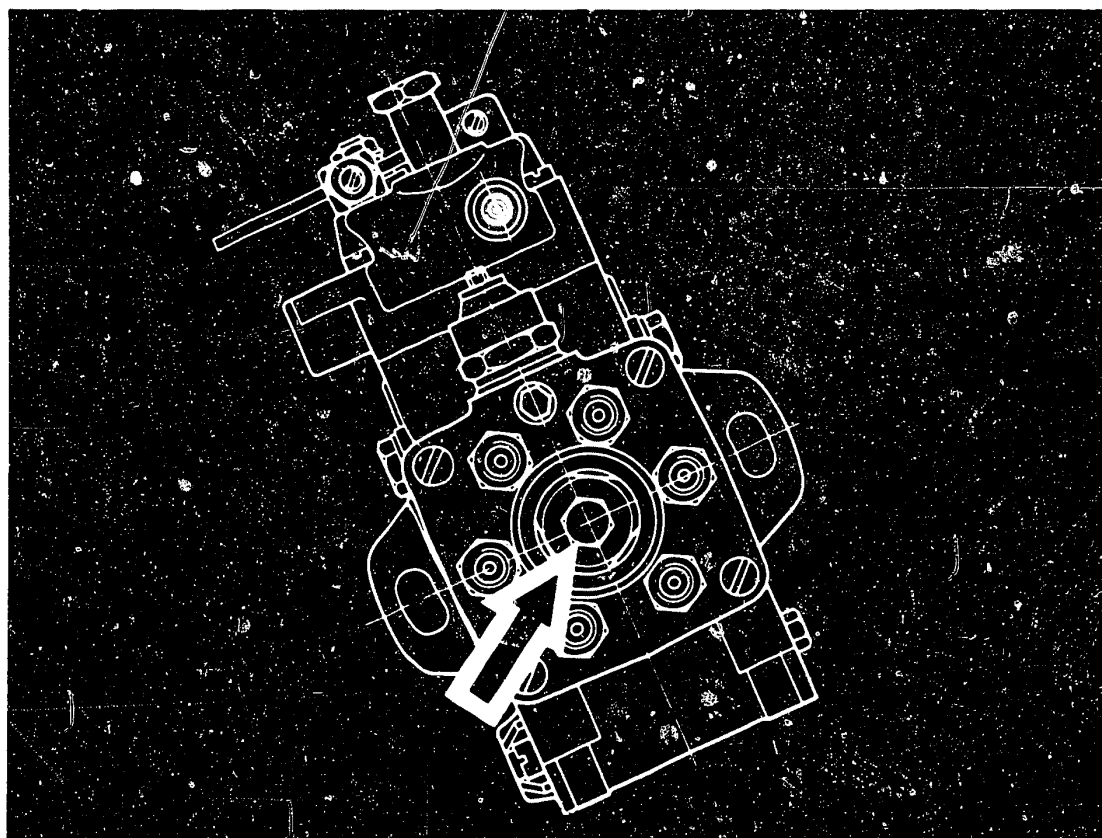




In various versions of distributor-type fuel-injection pump (VE), a hexagon-socket-head cap screw is positioned below the solenoid-operated valve (see picture, arrow).

To bleed these versions of pump, loosen this hexagon-socket-head cap screw. Operate starting motor until fuel escaping at this point is free of bubbles; then re-tighten hexagon-socket-head cap screw.

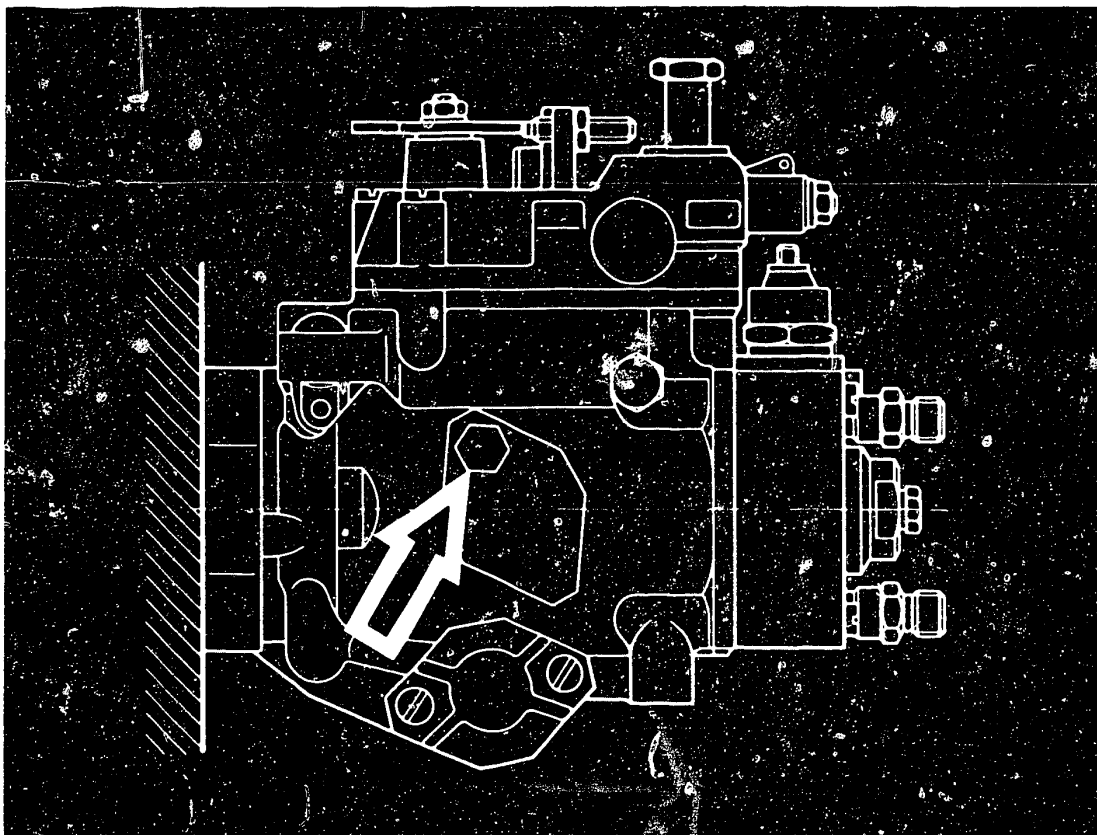




## 2. Horizontal installation

To bleed horizontally installed distributor-type pumps (see picture), it is necessary, as in the case of vertical installation, to loosen the hexagon screw (arrow) in the central screw plug of the hydraulic head, and to re-tighten it after the fuel escaping is free of bubbles.





In various versions of pump, the bleeder screw is positioned on the side of the pump housing, see picture. (Distributor-type pump is shown horizontal for better clarity).

To bleed these distributor-type pumps, loosen the hexagon screw (arrow) shown in the picture. Operate starting motor until fuel escaping at this point is free of bubbles; then re-tighten bleeder screw.

Published by:  
Robert Bosch GmbH  
Division KH  
After-Sales Service Department for  
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Automotive Equipment - After-Sales Service  
Department for Technical Publications KH/VDT  
Postfach 50, D-7000 Stuttgart 1.

Published by: After-Sales Service Department for  
Training and Technology (KH/VSK). Press date: 3.1985

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